Chapter 3
Description of Alternatives

[Note to reviewers: the data and figures presented in this chapter are currently under revision based on updated project alternatives information and GIS data. Please review this chapter with a focus on the format, structure, and impact conclusions at this time. Subsequent versions of this chapter will provide the updated data and figures.]

3.1 Introduction

As described in detail in Chapter 2, the BDCP is being proposed to address federal Endangered Species Act (ESA) and California Natural Communities Conservation Planning Act (NCCPA) compliance for the operation of the existing State Water Project (SWP) Delta facilities and for the construction and operation of conveyance facilities for the movement of water entering the Delta from the Sacramento Valley watershed to the existing SWP and federal Central Valley Project (CVP) pumping plants in the southern Delta. The BDCP is also proposed to provide for the conservation and management of covered species through actions—*conservation measures*—within the BDCP Plan Area that will contribute to the recovery of the species. These actions include protecting, restoring, and enhancing aquatic, riparian, and associated terrestrial natural communities and ecosystems, and reducing the adverse effects of diverting water on certain listed species while providing a reliable water supply.

This chapter describes the nine action laternatives and the No Action Alternative being considered for the BDCP (Plan). The action alternatives for the EIR/EIS have been developed to meet all or most of the purposes of the BDCP described above (and discussed in detail in Chapter 2). The nine action alternatives are variations of conservation plans that primarily differ in the location, design, and operation of conveyance facilities implemented under BDCP Conservation Measure (CM) 1. The range of alternatives also includes different amounts and types of habitat restoration and enhancement proposed under CMs 4 through 11. Other proposed conservation measures do not vary between alternatives, but they are similarly considered in a conservation package.

The BDCP is being proposed to set out an integrated conservation strategy to achieve the dual goals of ecosystem restoration and water supply reliability and to meet a range of specific biological goals and objectives. The BDCP includes a description of each element of the Conservation Strategy and the rationale for its inclusion in the Plan. However, only CM1 facilities and operations are described at a project level in this EIR/EIS. Accordingly, this EIR/EIS presents and analyzes the location, design, and operation of conveyance facilities implemented under CM1 at a project-level, while all other CMs are presented and analyzed at a program level (see Section 1.3.2, *Uses of this EIR/EIS*, for more detail on agency decision making related to project- and program-level approvals using this EIR/EIS).

Section 3.2 provides a brief summary of the overall conservation strategy and the conservation measures that are collectively intended to address the impacts of take on species covered by the Plan and to contribute to the recovery of the covered species. The reader is referred to the BDCP document for a more detailed discussion of the proposed conservation strategy, conservation measures, and covered activities. Section 3.3 presents an overview of the facilities and other project components that constitute the conservation measures and, in turn, the alternatives. The alternatives development process is described in Section 3.4 and in Appendix_ _, *Alternatives Screening*. This discussion discloses how the range of alternatives was developed for evaluation and describes those alternatives considered but rejected from further consideration and how thealternatives described within this chapter were selected. Section 3.5 describes each alternative in detail. Section 3.6 provides a detailed description of each component of the project alternatives, common to some or all of the alternatives. Section 3.7 summarizes the project implementation schedule. Section 3.8 and Appendix__, *Environmental Commitments*, presents the Environmental Commitments that are incorporated into the BDCP and all action alternatives.

3.2 Proposed Bay Delta Conservation Plan

As described in more detail in Section 3.4 and Appendix__, *Alternatives Screening*, a detailed process of considering alternatives has been ongoing as part of the development of the BDCP. During summer 2011, the alternatives were reduced to five"action alternatives" and the No Action Alternative. As part of the preparation of this EIR/EIS, these alternatives were renumbered to better represent the alternatives related to the particular alignment and conveyance option. Table 3-1 presents an overview of the alternatives and a crosswalk between the final range of the action alternatives and the revised numbering of the alternatives for presentation in the EIR/EIS. [*Note to reviewers: the "cross-walk" elements of this table are included for those more familiar with the alternatives numbering system used in modeling and described in the August 8, 2011 Alternatives Matrix. It may be removed prior to release of the public version of the Draft EIR/EIS*]

Table 3-1. Action Alternatives Evaluated in the BDCP EIR/EIS

Previous Alternative Number	EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes	North Delta Diversion Capacity (cfs)	Operations[c]	Conservation Components	Measures to Reduce Other Stressors
1	1A	Dual[a]	Pipeline/ tunnel	1, 2, 3, 4, 5; alts 1, 2, 3, 4, 5	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
1	1B	Dual[a]	East canal	1, 2, 3, 4, 5; alts 1, 2, 3, 4, 5	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
1	1C	Dual[a]	West canal	West side intakes 1, 2, 3, 4, 5	15,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
1A	2A	Dual[a]	Pipeline/ tunnel	1, 2, 3, 4, 5 (or 1, 2, 3, 6, 7)[b]; alts 1, 2, 3, 4, 5	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
1A	2B	Dual[a]	East canal	1, 2, 3, 4, 5 (or 1, 2, 3, 6, 7)[b]; alts 1, 2, 3, 4, 5	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
1A	2C	Dual[a]	West canal	West side intakes 1, 2, 3, 4, 5	15,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)

Previous Alternative Number	EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes	North Delta Diversion Capacity (cfs)	Operations[c]	Conservation Components	Measures to Reduce Other Stressors
2	3	Dual[a]	Pipeline/ tunnel	1, 2; alts 1, 2	6,000	Scenario A	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
2A	4	Dual[a]	Pipeline/ tunnel	1, 2, 3; alts 1, 2, 3	9,000	Scenario B	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
2B	5	Dual[a]	Pipeline/ tunnel	1; alt 1	3,000	Scenario C	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout); tidal habitat restoration limited to 25,000 acres	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
3	6A	Isolated	Pipeline/ tunnel	1, 2, 3, 4, 5; alts 1, 2, 3, 4, 5	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
3	6B	Isolated	East canal	1, 2, 3, 4, 5; alts 1, 2, 3, 4, 5	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
3	6C	Isolated	West canal	West side intakes 1, 2, 3, 4, 5	15,000	Scenario D	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)

Previous Alternative Number	EIR/EIS Alternative Number	Conveyance	Conveyance Alignment	Intakes	North Delta Diversion Capacity (cfs)	Operations[c]	Conservation Components	Measures to Reduce Other Stressors
4	7	Dual[a]	Pipeline/ tunnel	2, 3, 5; alts 2, 3, 5	9,000	Scenario E	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout); additional 20 linear miles of channel margin habitat enhancement and 10,000 acres of seasonally inundated floodplain	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
4A	8	Dual[a]	Pipeline/ tunnel	2, 3, 5; alts 2, 3, 5	9,000	Scenario F	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)
5	9	Through Delta	Through Delta channel modifications	Screened intakes at Delta Cross Channel and Georgiana Slough	15,000	Scenario G	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout); changes in the south Delta	per BDCP Steering Committee Proposed Project (3/25/10 BDCP Steering Committee Handout)

[a] The “dual” conveyance water delivery system would consist of the new north Delta diversion facilities and the existing SWP/CVP export facilities in the south Delta. The north Delta diversion would be the primary diversion point using specific operating criteria and would be operated in conjunction with the existing south Delta diversion when necessary to maintain water quality and when doing so minimizes impacts on fish. The existing south Delta diversion would only operate on its own when the north Delta diversion is nonoperational during infrequent periods for maintenance or repair.

[b] Under Alternatives 2A and 2B, a total of five intakes would be constructed and operated. Currently, intake locations 1–3 and either 4 and 5, or 6 and 7 are being considered.

[c] To clarify the alternative operational criteria, the various sets of operational guidelines are summarized and assigned letters as operational scenarios. For example, those guidelines set forth in the BDCP Steering Committee handout of 2/11/10 are identified as Operation Scenario A. Other operations proposals are summarized as different discrete operations scenarios. The operations scenarios are described in detail in Section 3.3.1.2.

3.2.1 Covered Activities

The BDCP includes *covered activities, associated federal actions, joint federal actions, and nonfederal actions*. Covered activities are those actions that are carried out by nonfederal entities, such as the California Department of Water Resources (DWR), and are expected to be covered by regulatory authorizations under Section 10 of the federal Endangered Species Act (ESA) and Section 2835 of the Natural Community Conservation Planning Act (NCCPA). The BDCP covered activities (Table 3-2) consist of activities in the Plan Area associated with the conveyance and export of water supplies from the State Water Project's (SWP's) Delta facilities and with the implementation of the BDCP Conservation Strategy. Each of these activities falls into one of four categories: (1) construction of new Delta facilities used to transport and deliver water for project purposes; (2) operation of such facilities; (3) facility maintenance, monitoring, and other associated ongoing activities associated with the SWP; and (4) implementation of certain BDCP conservation measures and of the monitoring and adaptive management programs as a part of the conservation measures. As noted in Chapter 1, the Plan Area includes the statutory Delta, the Suisun Marsh, and the Yolo Bypass. However, project implementation could also affect regions upstream of the Delta and throughout SWP and CVP Export Service Areas. Consequently, the project area encompasses a larger geographic area than the Plan Area, comprising three defined regions: the Upstream of the Delta Region, the Delta Region (as defined in Chapter 1), and the SWP and CVP Export Service Areas Region (Figure 1-4).

BDCP-associated federal actions are those BDCP-related actions that are carried out, funded, or authorized by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) within the Plan Area and that would receive appropriate ESA coverage through Section 7. These actions are: (1) operation of existing CVP Delta facilities to convey and export water in coordinated operations with the SWP, and (2) associated maintenance and monitoring activities. The CVP is operated in coordination with the SWP under the Coordinated Operations Agreement (COA). While the CVP and SWP are separate systems, they function in an integrated and coordinated manner. Additionally, there may be certain activities under the BDCP that would be carried out jointly by DWR and Reclamation. These actions are categorized as covered activities under ESA Section 10 and NCCPA Section 2835 for DWR because of DWR's involvement in these joint actions. However, ESA and CESA coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP are addressed through separate compliance processes and are not addressed in the BDCP.

BDCP covered activities are outlined in Section 3.3 and presented in detail in Sections 3.5 and 3.6. Associated federal actions and joint activities by DWR and Reclamation are outlined in Section 3.6.4.1. Unless specifically identified otherwise, these activities would be the same under all the action alternatives.

1 **Table 3-2. BDCP Covered Activities**

Covered Activities	Description
New water facilities construction, operations, and maintenance	This covered activity includes two major components: (1) construction of new water facilities, and (2) operations of new operational control facilities or changes to the operations of existing operational control facilities, including Fremont Weir; Yolo Bypass improvements and maintenance; North Bay Aqueduct Alternative Intake Project. Water operations measures, through the management of flows, will support ecosystem functions associated with aquatic resources.
Operations and maintenance of SWP facilities[a]	This includes activities that would be carried out by DWR to operate and maintain SWP facilities in the Delta after the BDCP is approved and implemented.
Cache Slough nonproject diversions	[*Currently being defined by BDCP*]
Habitat restoration, enhancement, and management activities	These activities include all actions that may be undertaken to implement the physical habitat conservation measures.
Activities to reduce effects of methylmercury contamination	These activities include actions to minimize the methylation of inorganic mercury in BDCP habitat restoration areas.
Activities to reduce predation and other sources of direct mortality	These activities include control of nonnative aquatic vegetation; predator control for covered fish species; and installation and operation of nonphysical fish barriers in the Delta
Adaptive management and monitoring programs	Various types of monitoring activities would be conducted during BDCP implementation, including preconstruction surveys, construction monitoring, compliance monitoring, effectiveness monitoring, and system monitoring.
Other conservation actions	These actions may include: (1) the continued operation and maintenance of an existing oxygen aeration facility in the Stockton Deep Water Ship Channel, which serves to increase dissolved oxygen concentrations and thereby minimize a potential fish passage barrier; and (2) the development of a delta and longfin smelt conservation hatchery by the USFWS .

[a] ESA and CESA coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP are addressed through separate compliance processes and not addressed in the BDCP.

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3.2.2 Conservation Strategy

The BDCP conservation strategy consists of multiple components that are designed to collectively achieve the overall BDCP planning goals of ecosystem restoration and water supply reliability. The Conservation Strategy includes biological goals and objectives; conservation measures; avoidance and minimization measures; and a monitoring, research, and adaptive management program. When implemented together, the specific conservation measures would achieve the biological goals and objectives of the proposed BDCP. The covered activities outlined above are included in the conservation measures (Table 3-3), and discussed in detail in Section 3.6.2. The conservation measures address stressors at the scale of ecosystems, natural communities, and species. CM1 through CM3 will improve the routing, timing, and amount of flow through the Delta while establishing an interconnected system of conservation lands across the Plan Area. CM4 through CM11 will restore, enhance, and manage physical habitat to expand the extent and quality of intertidal, floodplain, and other habitats across defined Conservation Zones and Restoration Opportunity Areas (ROAs) (Figure 3-1). The Plan Area is subdivided into 11 Conservation Zones within which conservation targets for natural communities and covered species' habitats have been established. ROAs encompass those locations in the Plan Area considered most appropriate for the restoration of natural communities, and within which conservation goals for covered species and natural communities would be achieved. The remaining conservation measures, CM12 through CM24, will reduce the adverse effects of various stressors on covered species; these include toxic contaminants, nonnative predators, illegal harvest, and nonproject water diversions.

The conservation strategy is divided into near-term (NT) and long-term (LT) implementation stages. The NT implementation, with an anticipated 15-year horizon, lasts until the north Delta diversion and the new water conveyance facilities are constructed and operational. Long-term implementation begins at year 15 and lasts 35 years, through the remainder of the proposed 50-year BDCP permit duration.

Table 3-3. Summary of Proposed BDCP Conservation Measures

Conservation Measure Number	Title
CM1	Water Facilities and Operations
CM2	Yolo Bypass Fisheries Enhancements
CM3	Natural Communities Protection
CM4	Tidal Habitat Restoration
CM5	Seasonally Inundated Floodplain Restoration
CM6	Channel Margin Habitat Enhancement
CM7	Riparian Habitat Restoration
CM8	Grassland Communities Restoration
CM9	Vernal Pool Complex Restoration
CM10	Nontidal Marsh Restoration
CM11	Natural Communities Enhancement and Management
CM12	Methylmercury Management
CM13	Nonnative Aquatic Vegetation Control
CM14	Stockton Deep Water Ship Channel Dissolved Oxygen Levels
CM15	Predator Control
CM16	Nonphysical Fish Barriers

Conservation Measure Number	Title
CM17	Illegal Harvest Reduction
CM18	Conservation Hatcheries
CM19	Urban Stormwater Treatment
CM20	Recreational Users Invasive Species Program
CM21	Nonnative Predator Control
CM22	Nonproject Diversions
CM23	Waterfowl and Shorebird Areas

Note: Implementation of habitat protection, enhancement, and restoration conservation measures, other than CM1, would require the preparation of site-specific implementation documents (some of which may be underway.) These site plans, as well as any additional environmental documentation, would be prepared in accordance with the schedule for the implementation of specific actions.

3.3 Components of the Alternatives: Overview

The BDCP consists of water facilities components combined with water conveyance operational components (collectively CM1); conservation components (CMs 2 through 11); and components related to reducing other stressors (CMs 12 through 24). Depending on the alternative, the water facilities components would create a new conveyance mechanism to divert water from the north Delta to existing SWP and CVP export facilities in the south Delta, interacting with operational guidelines to achieve the co-equal planning goals outlined above. The detail of the the water facilities components is described in greater detail in Section 3.6.1. Conservation components and components to address other stressors would support a number of the specific biological goals and objectives identified in the Plan. Each set of conservation components is described in greater detail in Sections 3.6.2 and 3.6.3, respectively. For the BDCP alternatives, a variety of new physical and operational components of the SWP are presented. This EIR/EIS describes and analyzes these components at a project level. These components are described in more detail in Section 3.6.1.

3.3.1 Overview of Water Facilities Components

3.3.1.1 Physical Components

The new or improved water diversion and conveyance facilities described herein would consist of a combination of the following primary components, depending on the action alternative. A number of these components are identified in Table 3-4 by alternative, and all are described in detail in Section 3.6.1.

- Intakes
  - New on-bank water intake facilities on the Sacramento River between Clarksburg and Walnut Grove. Alternatives 1A through 8 would entail between one and five 3,000 cubic feet per second (cfs)-diversion-capacity facilities in 17 alternative locations—12 alternative locations on the east bank of the river (for tunnel and east conveyance alternatives) and 5 potential locations on the west (for west conveyance alternatives). Any single alternative would construct between one and five intakes. These intakes would rise approximately 55 feet from river bottom to top of structure with a length of 900–1,600 feet, depending on

location. Under Alternative 9, two intakes with a capacity of 7,500 cfs each would be placed at the entrances to the Delta Cross Channel and Georgiana Slough. All intakes would be equipped with self-cleaning, positive barrier fish screens designed to be protective of salmonids and delta smelt. Fish screens would comply with California Department of Fish and Game (DFG), National Marine Fisheries Service (NMFS), and U.S. Fish and Wildlife Service (USFWS) fish screening criteria.

  - New intake facilities would necessitate the construction of new setback levees and transition levees to tie into the existing levees adjacent to intake facilities. Minor dredging and channel modification activities would also take place along the face of the intakes.

- Pumping plants
  - Intake pumping plants with a capacity of 3,000 cfs each to convey water from intake facilities into pipelines, eventually connecting to the rest of the conveyance structures. Each plant and its associated facilities would encompass approximately 20 acres adjacent to the intake facility. Tunnel, east, and west conveyance alternatives would construct between one and five intake pumping plants.
  - An Intermediate Pumping Plant with a capacity of 15,000 cfs to convey the water collected from the intake facilities between intermediate conveyance structures such as tunnels, canals, and forebays, depending on the structure of the particular alternative. One intermediate pumping plant would be constructed under the tunnel, east, or west conveyance alternatives.
  - Diversion pumping plants with a capacity of 250 cfs to provide dilution flow at the confluence of San Joaquin River and Head of Old River and upstream of the confluence of Middle River and Victoria Canal. The separate corridors alternative would construct these plants.
  - Pumping plant facilities could include sedimentation basins, solids handling facilities, transition structures, surge shafts or towers, one or two substations, transformers, a mechanical room, an access road, and other associated facilities and utilities. Some or all of these facilities would be associated with pumping plants under each alternative.
- Pipelines
  - Intake pipelines to carry water between intakes and intake pumping plants. Each intake facility would convey water through six 12-foot-diameter pipelines to the adjacent pumping plant. Each intake site associated with the tunnel, east, or west conveyance alternatives would include these pipelines.
  - Conveyance pipelines to carry water between intake pumping plants and other conveyance facilities such as tunnels, canals, and forebays. Two or four 16-foot-diameter conduits would be used for conveyance pipelines. Each intake site associated with the tunnel, east, or west conveyance alternatives would include these pipelines.
- Tunnels
  - A single-bore 29-foot-diameter tunnel to convey water more than 5 miles from intake pumping plants to a new Intermediate Forebay approximately 0.85 miles south of the confluence of Snodgrass Slough and the Sacramento River. This would apply to each alternative using the northernmost potential intake site and the tunnel conveyance alignment.

- A dual-bore 33-foot-diameter tunnel to convey water 33 miles from the new Intermediate Forebay to a new Byron Tract Forebay, adjacent to Clifton Court Forebay. This would be constructed for tunnel conveyance alternatives.
- One dual-bore 33-foot-diameter tunnel to convey water between the Intermediate Pumping Plant on Ryer Island and a proposed canal segment on Hotchkiss Tract. This would be constructed for west conveyance alternatives.
- Three tunnel segments to be used as siphons to carry water under Lost Slough/Mokelumne River, San Joaquin River, and Old River, connecting canal segments. East conveyance alternatives would construct these tunnel segments.

- Unlined or lined canals
  - An approximately 2,000-foot-long canal to carry water from the Byron Tract Forebay to existing approach canal to the Harvey O. Banks Pumping Plant. This canal would be constructed for tunnel, east, and west conveyance alternatives. For west conveyance alternatives, this canal would be extended to convey water into the existing approach canal for the C. W. "Bill" Jones Pumping Plant.
  - A canal alignment to convey water between the intake pumping plants and the Byron Tract Forebay across the east Delta, generally between Interstate (I-) 5 and the South Mokelumne and Middle Rivers. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed for the east conveyance alternatives.
  - A canal alignment to convey water between intake pumping plants and an Intermediate Pumping Plant/tunnel entrance on Ryer Island. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed under the west conveyance alternatives.
  - A canal alignment to convey water between the tunnel exit portal on the Hotchkiss Tract and Byron Tract Forebay. Canal segments would generally have a maximum top width of 700 feet and a depth of 23.5 feet. This canal would be constructed under the west conveyance alternatives.
  - A new 4,000-foot canal on Coney Island, adjacent to Victoria Canal, to connect the water supply corridor between siphons at Old River and West Canal across Coney Island. The separate corridors alternative would construct this canal.
  - A 4,000-foot intertie canal from Clifton Court Forebay to Tracy Fish Collection Facility (Tracy Fish Facility). The separate corridors alternative would construct this canal.
- Forebays
  - A 750-acre Intermediate Forebay to store water between intake facilities and the tunnel conveyance segment about 4,500 feet south of the confluence of Snodgrass Slough and the Sacramento River. This forebay would be constructed for tunnel conveyance alternatives.
  - A 630-acre Byron Tract Forebay adjacent to Clifton Court Forebay to store water between new conveyance structures and existing SWP and CVP south Delta export facilities. For west conveyance alternatives, this new forebay would be constructed northwest of Clifton Court Forebay. For tunnel and east conveyance alternatives, the new forebay would be constructed on the southeast side of Clifton Court Forebay.

- Fish Facilities
  - Fixed and operable barriers utilizing a range of gate technologies to variously allow the passage of fish, water, and boats through existing channels within the Delta. Operable barriers would be constructed under the separate corridors alternative and under those alternatives using Operational Scenario B.
  - Vertical, structurally reinforced wedge wire screen panels of stainless steel with 1/16-inch openings (i.e., fish screens). The screens would be sized to reduce effects on fish and aquatic resources. Each intake under any alternative would incorporate fishscreens.
- Levees to protect new channel fill areas and to serve modified channels and intake facility sites. Minor levee modifications would be necessary under all alternatives; the separate corridors alternative would involve additional levee-related activities.
- Culvert siphons to convey water under existing channels and between sections of canals (e.g., through tunnels) or other conveyance facilities. These would be constructed under the east, west, and separate corridors alternatives.
- Gates and similar control structures to control the flow of water through conveyance facilities and to facilitate maintenance of conveyance structures. Control structures would be constructed as part of all alternatives.
- A precast segment plant and yard to produce tunnel segments. The plant would include offices, materials storage, and casting facilities. The plant and yard would be located XXXXXXXXXXXXX
- Concrete batch plants and fuel stations. The volume of concrete utilized for the conveyance options will require locating concrete batch plants at the project site rather than importing concrete from outside suppliers. A suitable source for clean water will be required for each batch plant. Batch plants and fuel stations would be located side by side, and would range in size from approximately 2 acres each to up to 40 acres. Depending the the alternative selected, concrete batch plants and fuel stations would be construted at one or more of the following locations (no locations have been identified for Alternative 9):
- Tunnel Conveyance (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, and 8)
  - An approximately 2 acre concrete plant and 2 acre fuel station at the location of intake 2
  - An approximately 2 acre concrete plant and 2 acre fuel station at the location of intake 4
  - An approximately 40 acre concrete plant and 2 acre fuel station approximately 2.5 miles north of SR 12
  - An approximately 40 acre concrete plant and 2 acre fuel station located along the tunnel alignment approximately 8.5 miles south of SR 12
  - An approximately 2 acre concrete plant and 2 acre fuel station located along the tunnel alignment on Byron-Bethany Road
- East Canal Conveyance
  - An approximately 2 acre concrete plant and 2 acre fuel station at the location of intake 2
  - An approximately 2 acre concrete plant and 2 acre fuel station at the location of intake 4
  - An approximately 25 acre concrete plant and 2 acre fuel station located along the canal alignment just south of Snodgrass Slough

    - An approximately 40 acre concrete plant and 2 acre fuel station located along the tunnel alignment approximately 8.5 miles south of SR 12
- West Canal Conveyance
    - An approximately 2 acre concrete plant and 2 acre fuel station along the canal alignment, adjacent to Willow Point Road
    - An approximately 2 acre concrete plant and 2 acre fuel station located between intakes 3 and 4
    - An approximately 40 acre concrete plant and 2 acre fuel station located along the canal alignment approximately 1 mile south of the SR 84/SR 220 junction
    - An approximately 40 acre concrete plant and 2 acre fuel station located along the canal alignemtn, just north of Franks Tract
    - An approximately 2 acre concrete plant and 2 acre fuel station located along the canal alignment approximately 1 mile north of the Byron Highway
- Barge unloading facilities. Temporary barge unloading facilities would be constructed at locations along the alternatives for the delivery of construction materials. These facilities would be sized to accommodate various deliveries (tunnel segments, batched concrete, major equipment, etc). Access roads from these facilities to the construction work area would be necessary. The barge unloading facilities would be removed following construction.

Table 3-4. Water Conveyance Facilities Components of Each Alternative

	Alternative															
Component	No Action	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9
New North Delta Intakes		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
New Intake Pumping Plants		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
New Diversion Pumping Plants																X
New Intermediate Pumping Plant		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Use of Existing SWP and CVP South Delta Intake Facilities	X	X	X	X	X	X	X	X	X	X				X	X	X
Byron Tract Forebay[1]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Intermediate Forebay		X			X			X	X	X	X			X	X	
Primary Conveyance Facility																
Pipelines/Tunnels		X		X	X		X	X	X	X	X		X	X	X	
Canals			X	X		X	X					X	X			
Channels	X															X
New Operable Barriers					X	X	X		X							X
Fish Movement and Habitat Corridor around Clifton Court Forebay																X

[1] Byron Tract Forebay currently refers to proposed forebays both north and south of Clifton Court Forebay

- Other facilities to support the function of the conveyance include new bridges to connect existing roads and highways, new access roads, improvements to local drainage systems affected by the project, and other utilities improvements. Some areas would also be temporarily or permanently dedicated to borrows, spoils, or tunnel muck.

3.3.1.2 Operational Components

[*Note to reviewers: This section is pending and will summarize proposed modifications to current operations. To clarify the alternative operational criteria, sets of operational guidelines will be summarized and assigned letters as operational scenarios. For example, those guidelines set forth in the BDCP Steering Committee handout of 2/11/10 will be identified as Operational Scenario A. Other modifications to existing operations would be summarized as different discrete operational scenarios.*]

As noted in Section 3.2.1, the BDCP would guide the operations of covered activities, BDCP-associated federal actions, and joint federal and nonfederal actions. Covered activities are discussed in Section 3.2.1 and listed above in Table 3-2. Water Supply Operations Scenarios for BDCP Alternatives

- Scenario A would include specific criteria guiding water supply parameters at a variety of locations and facilities. This includes criteria for: north Delta diversion bypass flows; south Delta channel flows; Fremont Weir / Yolo Bypass operations; Delta inflow and outflow; Delta Cross Channel gate operations; Rio Vista minimum instream flows; Delta water quality and residence time, and in-Delta agricultural, municipal, and industrial water quality requirements (BDCP Steering Committee handout, 2/11/10). This scenario applies to Alternatives 1A, 1B, 1C, and 3.
- Scenario B would incorporate criteria for the same elements as those referenced under Scenario A. These include parameters outlining: north Delta diversion bypass flows; south Delta channel flows; Fremont Weir/Yolo Bypass operations; Delta Cross Channel Gate operations; Rio Vista minimum instream flows; Delta inflow and outflow; Delta water quality and residence time standards; and in-Delta agricultural, municipal, and industrial water quality requirements ("Scenario 6," Rationale for Five Agency Proposed Alternative BDCP Initial Project Operations Criteria, 5/18/11). This scenario would add an operable barrier at Head of Old River. This scenario applies to Alternatives 2A, 2B, 2C, and 4.
- Scenario C would adopt the operational guidelines of Scenario A north of the Delta. South of the Delta, this Scenario would rely upon existing Biological Opinions with criteria related to Fall X2, Old and Middle River flows, and San Joaquin export and inflow ratio. This scenario applies only to Alternative 5.
- Scenario D would be modified from Scenario A to eliminate use of south Delta intakes and add criteria surrounding Fall X2. This scenario applies to Alternatives 6A, 6B, and 6C.
- Scenario E would be modified from Scenario A. These operational criteria would apply to Alternative 7.
- Scenario F is under development and could include up to 1.5 maf in increased Delta outflow. This scenario applies only to Alternative 8.
- Scenario G would be similar to those described under Scenario A but would be modified to conform to the conveyance components of the separate corridors option. This scenario applies only to Alternative 9.

Other Operational Elements of BDCP

In addition to the SWP operational issues addressed by the BDCP, federal actions associated with the BDCP include operation and maintenance of CVP-related activities within the Delta that are authorized, funded, or carried out by Reclamation. The CVP's Delta Division facilities in the Plan Area consist of the Delta Cross Channel; the eastern portion of the Contra Costa Canal, including the Contra Costa Water District's (CCWD) diversion facility at Rock Slough; the Jones Pumping Plant (formerly Tracy Pumping Plant); the Tracy Fish Collection Facility; the northern portion of the Delta Mendota Canal; and Central Valley Project diversions. From a water supply operational standpoint, joint Federal and nonfederal actions include the operations of the Joint Point of Diversion; operations of new water intake and conveyance facilities; operations associated with water transfers; and operations and maintenance of Suisun Marsh Facilities including the Suisun Marsh Salinity Control Gates, Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, and various salinity monitoring and compliance stations throughout the Marsh. These facilities and their operations are described in further detail in Section 3.6.4.

3.3.2 Overview of Conservation Components

A primary conservation goal of the BDCP is to restore, enhance, and manage up to 80,000 acres of tidal habitat, riparian, and seasonally inundated floodplain habitats for the benefit of fish, wildlife, plants, and ecosystem processes in the Delta and Suisun Marsh. Habitat restoration, enhancement, and management activities are covered activities under the BDCP; they include all actions that may be undertaken to implement the physical habitat conservation measures. This EIR/EIS describes and analyzes these components at a program level. These conservation components are described in detail in Section 3.6.2 and Appendix__.

The BDCP physical habitat conservation program is organized geographically across the northern, eastern, southern, and western regions of the Delta. It is also organized by habitat type, and temporally into NT and LT implementation phases.

Each of the action alternatives would include implementation of restoration, enhancement, and management activities, which would entail the following.

- Restoration of the following habitat types: tidal; seasonally inundated floodplain; channel margin; riparian habitat; grassland communities; vernal pool complex; and nontidal marsh habitat. Target acreages would vary for some alternatives; these are discussed in detail in Section 3.6.2.
- Preparation and implementation of management plans for protected natural communities and covered species habitats within those communities. The following natural communities would receive protection, restoration, and enhancement, and would be incorporated into a conservation reserve system: tidal habitat, valley/foothill riparian habitat, grassland habitat, nontidal freshwater perennial emergent wetland and nontidal perennial aquatic habitat, alkali seasonal wetland complex, vernal pool complex, managed wetlands, inland dune scrub, and agricultural habitats.

3.3.3 Overview of Conservation Components Related to Reducing Other Stressors

The BDCP has identified several issues, beyond water exports and habitat conditions that affect the survival of covered species in the Delta. These "other stressors" include but are not limited to exposure to contaminants, competition, predation and changes to the ecosystem caused by nonnative species, entrainment at water intake pumps not operated by SWP and CVP, and fish passage. Implementation of the following BDCP components related to reducing other stressors (CMs 12 through 24; Table 3-3) is proposed under all alternatives except the No Action Alternative. Section 3.6.3 and Appendix__ provide a detailed description of these components.

- Control of methylmercury load in BDCP conservation sites.
- Control nonnative submerged and floating aquatic vegetation in BDCP tidal habitat restoration.
- Operate and maintain an oxygen aeration facility in the Stockton Deep Water Ship Channel to increase dissolved oxygen concentrations.
- Reduce local effects of predators on covered fish species.
- Install nonphysical barriers at the junction of channels with low survival of outmigrating juvenile salmonids to deter fish from entering these channels.

- Reduce illegal harvest of covered fish species.
- Establish new and expand existing conservation propagation programs for delta smelt and longfin smelt.
- Treat pollutant discharges from urban stormwater.
- Reduce the risk of invasive species introduction from recreational vessels.
- Revise the recreational fishing regulations to control nonnative predators
- Develop a mark-selection fishery program that would enable regulations to prohibit harvest of wild fish as opposed to those grown in hatcheries.
- Install screens and alter non-project diversions, as appropriate, to reduce the risk of entrainment of covered fish species.
- Waterfowl and Shorebird Areas to support continued recreational activities.

3.4 Alternatives Development Process

CEQA and NEPA generally require a detailed analysis of a reasonable range of alternatives to a proposed project that would attain all or most of the basic project objectives while avoiding or substantially lessening project impacts and accomplish the project purpose and need. A range of reasonable alternatives is analyzed to define the issues and provide a clear basis for choice among the options. The CEQA/NEPA analysis must also include an analysis of the no project or no action alternative.

CEQA requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified for the project in an EIR. The State CEQA Guidelines state that the range of alternatives required to be evaluated in an EIR is governed by the "rule of reason"; the EIR needs to describe and evaluate only those alternatives necessary to permit a reasonable choice and to foster informed decision making and informed public participation (CEQA Guidelines Section 15126.6[f]). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly and those that could impede to some degree the attainment of all the project objectives (Section 15126.6[b]), as long as they are still considered potentially feasible. CEQA does not require the alternatives to be evaluated at the same level of detail as the proposed project.

Similarly, the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1502.14) require all reasonable alternatives to be objectively evaluated in an EIS, so that each alternative is evaluated at what amounts to an equal level of detail (40 CFR 1502.14[b]). Alternatives that cannot reasonably meet the purpose and need do not require detailed analysis. An EIS must briefly describe alternatives to the proposed action where unresolved resource conflicts exist. NEPA does not necessarily require alternatives to offer some environmental benefit over the proposed action; however, neither does it discourage consideration of alternatives with lesser effects.

3.4.1 Development of Alternatives

[*Note to reviewers: This section to be completed following CH2M Hill's completion of the alternatives screening appendix.*]

3.4.2 Screening Criteria

[*Note to reviewers: This section to be completed following CH2M Hill's completion of the alternatives screening appendix.*]

3.4.3 Screening Results

[*Note to reviewers: This section to be completed following CH2M Hill's completion of the alternatives screening appendix.*]

3.4.4 Alternatives Considered and Dismissed from Further Evaluation

[*Note to reviewers: This section to be completed following CH2M Hill's completion of the alternatives screening appendix.*]

3.5 Alternatives

The nine action alternatives differ in the location, design, and operation of conveyance facilities/improvements implemented under CM1. With the exception of the No Action Alternative, each alternative selected for detailed evaluation in this EIR/EIS would involve some level of construction of conveyance facilities/improvements to the system for diverting water to the existing SWP and CVP south Delta export facilities. Additionally, as noted above, each action alternative would include operational criteria for the water supply infrastructure, habitat conservation components, and measures to mitigate the impact of other stressors on covered species. Table 3-1 provides a summary of the alternatives evaluated in the EIR/EIS.

The following alternatives, except for the No Action Alternative, were found to be potentially feasible, to meet all or most of the BDCP objectives (which incorporate and add to the BDCP purpose statement and project need, see Chapter 2 for more detail), and to have some potential to avoid or substantially lessen the adverse effects of the proposed BDCP; they were accordingly carried forward for detailed evaluation in this EIR/EIS.

The alternatives differ primarily in their physical conveyance facility infrastructure/improvements, the locations of facilities, and diversion capacities. Other differences are associated with operational criteria for water supply facilities and in the acreage of habitats that would be restored or enhanced. The major physical/structural components of each alternative are summarized in Table 3-4.

3.5.1 No Action Alternative

CEQ regulations of implementing NEPA require an EIS to include evaluation of a no action alternative (40 CFR 1502.14). Within the Lead Agencies' discretion under NEPA, the no action alternative may be described the future circumstances without the project and can also include predictable actions by persons or entities, other than the federal agencies involved in a project, acting in accordance with current management direction or level of management intensity. When the proposed action involves updating an ado-pted management plan or program, the no action alternative includes the continuation of the existing management plan or program.

Under CEQA, an EIR is required to analyze the no project alternative. The no project alternative allows decision makers to use the EIR to compare the impacts of approving the proposed project with the future conditions of not approving the proposed project (although it is not to be used as the baseline for determining the environmental impacts of the proposed action). State CEQA Guidelines Section 15126.6, Subdivision (e)(2), indicates that no project conditions may include some reasonably foreseeable changes in existing conditions and changes that would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services. This qualifying language is intended to limit the number of assumptions a CEQA lead agency can make about potential future actions. CEQA would prohibit the no project alternative from incorporating the NEPA no action alternative approach if the no action alternative included assumptions for agencies other than the federal lead and cooperating agencies that go beyond existing plans, infrastructure, and services.

For this analysis, the No Action Alternative assumptions are limited to existing conditions, programs adopted during the early stages of development of the EIR/EIS, facilities that are permitted or under construction during the early stages of development of the EIR/EIS, and changes due to climate change that would occur with or without the proposed project or alternatives. These assumptions represent continuation of the existing plans, policies, and operations and conditions that represent continuation of trends in nature.

Because the BDCP no action alternative assumptions are consistent with the requirements and limitations prescribed by CEQA, from this point forward in this document, the No Action Alternative also represents the No Project Alternative. The No Action Alternative assumptions includes the basic description of No Action Alternative, assumptions related to the State Water Project (SWP) and Central Valley Project (CVP), ongoing programs and policies by governmental and non-profit entities, projections related to climate change, and assumptions related to annual actions that vary every year. The detailed elements of the No Action Alternative are presented in Appendix__, *Alternatives Development Report.*

3.5.2 Alternative 1A—Dual Conveyance with Tunnel and Intakes 1–5

3.5.2.1 Physical and Operational Components

Alternative 1A would primarily convey water from the north Delta to the south Delta through pipelines/tunnels. This alternative would divert water from the Sacramento River throughfive fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Walnut Grove. Water would travel in pipelines from the intakes to a sedimentation basin and solids lagoon before reaching the intake pumping plants. From the intake pumping plants water would be pumped into another set of pipelines to an Intermediate Forebay (via a transition structure) or to a tunnel (Tunnel 1) that would also carry water to the intermediate forebay. From this forebay, water could be pumped or conveyed by a gravity bypass system into a dual-bore tunnel (Tunnel 2) that would run south to a new forebay near Byron Tract, adjacent to Clifton Court Forebay. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes and flows to south Delta pumping plants. Byron Tract Forebay would be designed to provide water to Jones Pumping Plant 24 hours per day while minimizing on-peak pumping and limiting diversions to two 6-hour ebb tide periods at north Delta intakes.

New connections would be constructed between the new Byron Tract Forebay and the Banks and Jones Pumping Plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Alternative 1A would entail the continued use of the CVP and SWP south Delta export facilities.

A map and a schematic diagram depicting the conveyance facilities associated with Alternative 1A are provided in Figures 3-2 and 3-3. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5.

Facilities under Alternative 1A would be operated to provide diversions up to a total of 15,000 cfs from the new north Delta intakes. Operations of the existing SWP and CVP south Delta export facilities would continue as described above (Section 3.5.1) for the No Action Alternative.

Alternative 1A water conveyance operations would follow the guidelines described as Scenario A and would include criteria for north Delta diversion bypass flow s, south Delta Old and Middle River (OMR) flows, South Delta Export/Inflow Ratio, flows over Fremont Weir into Yolo Bypass, Delta inflow and outflow, Delta Cross Channel gate operations, Rio Vista minimum in-stream flow, operations for Delta water quality and residence, and water quality for agricultural and municipal/industrial diversions. These criteria are discussed in detail in Section 3.6.4.2.

Alternative 1A would include the following new water facilities components, which are described in detail in Section 3.6 (Appendix __).

- Five north Delta intakes with fish screens along the east bank of the Sacramento River (Intakes 1–5).
- Pipelines conveying water from intakes to intake pumping plants.
- Sedimentation basins and solids handling facilities.
- Intake pumping plants at each intake location; associated facilities include an access road, electrical substation, and transformers.
- Discharge pipelines conveying water from intake pumping plants to an initial tunnel (Tunnel 1) or a transition structure.
- Surge shafts at any intake pumping plant site that feeds water into an initial tunnel (Tunnel 1).
- Transition structures, such as stop logs and vents, between discharge pipelines and larger conveyance pipelines.
- Conveyance pipelines between transition structures and Intermediate Forebay transition structures with radial gates and stop logs.
- An Intermediate Forebay near Courtland.
- An Intermediate Forebay gravity bypass that would allow water in the Intermediate Forebay to be diverted by gravity to either bore of Tunnel 2.

- An Intermediate Pumping Plant that would pump water from the Intermediate Forebay into Tunnel 2; associated features would include an access road, electrical substations, and transformers.
- A tunnel (Tunnel 2) between the Intermediate Pumping Plant and Byron Tract Forebay.
- Byron Tract Forebay adjacent to and south of Clifton Court Forebay
- Connections and control structures to the Banks and Jones Pumping Plants.
  - A canal and set of gates between Byron Tract Forebay and the approach canal to the Banks Pumping Plant.
  - A set of gates in the approach canal to the Banks Pumping Plant upstream of the connection to Byron Tract Forebay
  - A set of gates at the outlet between the embankment of the Byron Tract Forebay and the approach canal to the Jones Pumping Plant
  - A set of gates in the approach canal to the Jones Pumping Plant upstream of the connection to Byron Tract Forebay.
- Transmission lines running from the existing electrical grid to project substations.
- Borrows, spoils, and tunnel muck storage/disposal areas.

Table 3-5. Summary of Pipeline/Tunnel Conveyance Physical Characteristics

Feature Description / Surface Acreage	Approximate Characteristics
Overall project / 5,700[a]	
Conveyance capacity (cfs)	3,000–15,000[a]
Overall length (miles)	45[a]
Intake facilities / 1,600[a]	
Number of in-river screened intakes	1–5[a]
Flow capacity at each intake (cfs)	3,000
Intake pumping plants / (included with intake facilities)	
6 Pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	30–57
Total electric load (MW)	65[a]
Tunnels / 370[a] (permanent subsurface easement = 2,000 acres)	
Tunnel 1 connecting Intake 1 to Tunnel 2, maximum flow 3,000 cfs	
Tunnel length (ft)	27,000[a]
Number of tunnel bores; number of shafts (total)	1; 2
Tunnel finished inside diameter (ft)	29
Tunnel 2 connecting Intermediate Pumping Plant to Byron Tract Forebay, maximum flow 15,000 cfs	
Tunnel length (ft)	176,000
Number of tunnel bores; number of shafts (total)	2; 14
Tunnel finished inside diameter (ft)	33
Intermediate Forebay / 1,200	
Water surface area (acres)	750
Active storage volume (af)	5,250

Feature Description / Surface Acreage	Approximate Characteristics
Intermediate pumping plant (in Reach 2, at southern end of Intermediate Forebay)	
Number of pumps, capacity per pump (cfs)	10 at 1,500 (high head) 6 at 1,500 (low head)
Total dynamic head (ft)	0– 90
Total electric load (MW)	136
Byron Tract Forebay / 900	
Water surface area (acres)	630
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	210[a]

af = acre-feet
cfs = cubic feet per second
ft = feet
MW = megawatt
[a] Acreages, lengths, capacities, and other by alternative.

3.5.2.2 Conservation Components

Alternative 1A includes the following habitat conservation components, which are described in detail in Section 3.6.2 (Appendix __).

- 65,000 acres of restored freshwater and brackish tidal habitat within the BDCP ROAs (CM4).
- 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south Delta (CM5).
- 20 linear miles of channel margin habitat enhancement in the Delta (CM6).
- 5,000 acres of restored valley/foothill riparian habitat (CM7).
- 2,000 acres of restored grassland and 8,000 acres of protected or enhanced grassland within BDCP Conservation Zones 1, 8, and/or 11 (CM8).
- Restored vernal pool complex to achieve no net loss and 600 acres of protected vernal pool complex within Conservation Zones 1, 8, and/or 11 (CM9).
- 400 acres of restored nontidal freshwater marsh within Conservation Zones 2 and 4 (CM10).
- 400 acres of protected alkali seasonal wetland complex in Conservation Zones 1, 8, and 11 (CM3 and CM11)
- 16,620–32,640 acres of protected agricultural habitat areas (CM3 and CM11).

3.5.3 Alternative 1B—Dual Conveyance with East Canal and Intakes 1–5

3.5.3.1 Physical and Operational Components

Under Alternative 1B, five fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Walnut Grove would divert water into pipelines leading to intake pumping plants. Water would travel through sedimentation basins and be pumped into another set of pipelines, eventually reaching a lined or unlined canal. Once in the canal, gravity would carry water south along the eastern side of the Delta to an Intermediate Pumping Plant, where it would be raised to an elevation allowing gravity to carry it through another canal to the new Byron Tract Forebay, adjacent to and south of Clifton Court Forebay. Along the way, diverted water would travel under existing watercourses through culvert siphons or tunnel siphons. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes and flows to south Delta pumping plants. Byron Tract Forebay would be designed to provide water to Jones Pumping Plant 24 hours per day while minimizing on-peak pumping at north Delta intakes and allowing pumping criteria limit diversions to two 6-hour ebb tide periods. A map and schematic depicting the conveyance facilities associated with Alternative 1B are provided in Figures 3-4 and 3-5; characteristics of this alternative are summarized in Table 3-1.

New connections would be created between the new Byron Tract Forebay and Banks and Jones Pumping Plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Use of existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant would continue. This facility could convey up to 15,000 cfs from the north Delta. It would be approximately 49 miles long from the canal headworks to the California Aqueduct.

Alternative 1B water conveyance operations would follow parameters described as Scenario A and would include criteria for north Delta diversion bypass flows, south Delta OMR flows, South Delta Export/Inflow Ratio, flows over Fremont Weir into Yolo Bypass, Delta inflow and outflow, Delta Cross Channel gate operations, Rio Vista minimum in-stream flow, operations for Delta water quality and residence,and water quality for agricultural and municipal/industrial diversions. Water conveyance operational criteria are discussed in detail in Section 3.6.4.2.

Alternative 1A water conveyance operations would follow the guidelines described as Scenario A and would include criteria for north Delta diversion bypass flow criteria, south Delta Old and Middle River (OMR) flow criteria, South Delta Export/Inflow Ratio, flow criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, Delta Cross Channel gate operations, Rio Vista minimum in-stream flow criteria, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions. These criteria are discussed in detail in Section 3.6.4.2.

As shown in Table 3-4, Alternative 1B would have the same water conveyance facility components as Alternative 1A, except that the primary conveyance would be a lined or unlined canal rather than pipelines/tunnels in the east Delta and there would be no Intermediate Forebay. Additionally, Alternative 1B would include the following new water facility components.

- Conveyance pipelines between transition structures and canal transition structures with radial gates and stop logs.

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- Lined or unlined canal between the intake pumping plants and an Intermediate Pumping Plant.
- An Intermediate Pumping Plant just north of the town of Holt would lift diverted water from the northern two-thirds of the canal to the southern third of the canal, and would include a forebay from the upstream canal to the pump bays, an electrical substation, and transformers.
- A transition structure and discharge pipelines connecting the Intermediate Pumping Plant to the downstream canal.
- A lined or unlined canal between the Intermediate Pumping Plant and the Byron Tract Forebay
- Eight inverted culvert siphons along the conveyance alignment to convey diverted water under existing shallow watercourses.
- Three tunnel siphons along the conveyance alignment to convey diverted water under existing deep watercourses.
- Nineteen bridge crossings (two state highway and seventeen local, county, or private road bridges) along the conveyance alignment.
- Other road and utility crossings, including drainage and irrigation facilities.

An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes,) is presented in Table 3-6. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1. and Appendix __.

Table 3-6. Summary of East Conveyance Physical Characteristics

Feature Description / Acreage[a]	Approximate Characteristics
Overall project / 10,000	
Potential conveyance capacity (cfs)	15,000
Overall length (miles)	49
Intake facilities / 770 (Sacramento River)	
Number of on-bank screened intakes	5
Flow capacity at each intake (cfs)	3,000
Intake pumping plants / (included with intake facilities) (Sacramento River)	
One pumping plant with sedimentation basin per intake (each)	5
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	21
Total electric load (MW)	32 MW
Isolated conveyance canal / 6,600	
Type	Unlined or lined
Top width (approximate maximum, ft)	700 (location-specific)
Invert width (ft)	340
Depth (bottom to water surface)	23.5
Side slopes (H:V)	3:1, 8:1
Average permanent ROW width (ft)	1,400
26- by 26-foot culvert siphons / 1,100	
Stone Lakes Drain, length (ft)	1,700

Feature Description / Acreage[a]	Approximate Characteristics
Beaver Slough, length (ft)	1,900
Hog Slough, length (ft)	1,900
Sycamore Slough, length (ft)	2,000
White Slough, length (ft)	2,300
Disappointment Slough, length (ft)	2,400
BNSF Railroad, length (ft)	1,500
Middle River, length (ft)	2,400
Tunnel Siphons / 470	
Lost Slough/Mokelumne River tunnel	
Tunnel length (ft)	5,400
Number of tunnel bores; number of shafts (total)	2, 4
Tunnel finished inside diameter (ft)	33
San Joaquin River tunnel	
Tunnel length (ft)	2,700
Number of tunnel bores; number of shafts (total)	2, 4
Tunnel finished inside diameter (ft)	33
Old River tunnel	
Tunnel length (ft)	1,700
Number of tunnel bores; number of shafts (total)	2, 4
Tunnel finished inside diameter (ft)	33
Intermediate pumping plant / 60 (In Reach 11, north of BNSF crossing)	
Number of pumps, capacity per pump (cfs)	15 at 1,000 2 at 500
Total dynamic head (ft)	31
Total electric load (MW)	45
Byron Tract Forebay / 810	
Type	Lined or unlined
Water surface area (acres)	600
Active storage volume (af)	4,300
Power Requirements	
Total Conveyance Electric Load (MW)	86

af = acre-feet
BNSF = Burlington Northern and Santa Fe Railroad
cfs = cubic feet per second
ft = feet/foot
H:V = horizontal to vertical ratio
MW = megawatt

[a] Acreage is for permanent facilities and associated temporary disturbance. Overall project acreage includes facilities not listed, such as bridge abutments.

3.5.3.2 Conservation Components

Conservation components under Alternative 1B would be identical to those under Alternative 1A.

3.5.4 Alternative 1C—Dual Conveyance with West Canal and Intakes W1–W5

3.5.4.1 Physical and Operational Components

Under Alternative 1C, five fish-screened intakes on the west bank of the Sacramento River between Clarksburg and Walnut Grove would divert water into pipelines leading to intake pumping plants. Water would travel through sedimentation basins and be pumped into another set of pipelines, eventually reaching a lined or unlined canal. Once in the canal, gravity would carry water south along the western side of the Delta to an Intermediate Pumping Plant, where it would be pumped through a tunnel, eventually reaching another canal leading to the new Byron Tract Forebay, located adjacent to and north of Clifton Court Forebay. Along the way, diverted water would travel under existing watercourses and one rail crossing through culvert siphons. This arrangement would enhance water supply operational flexibility, using forebay storage capacity to regulate flows from north Delta intakes and flows to south Delta pumping plants. Byron Tract Forebay would be designed to provide water to Jones Pumping Plant 24 hours per day while minimizing on-peak pumping at north Delta intakes and allowing pumping criteria to limit diversions to two 6-hour ebb tide periods. A map and schematic depicting the conveyance facilities associated with Alternative 1C are provided in Figures 3-6 and 3-7; characteristics of this alternative are summarized in Table 3-1.

New connections would be created between the Byron Tract Forebay and Banks and Jones Pumping Plants, along with control structures to regulate the relative quantities of water flowing from the north Delta and the south Delta. Use of existing SWP and CVP south Delta export facilities would continue. This facility could convey up to 15,000 cfs from the north Delta.

Alternative 1C water conveyance operational criteria include north Delta diversion bypass flow criteria, south Delta OMR flow criteria, South Delta Export/Inflow Ratio, flow criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, Delta Cross Channel gate operations, Rio Vista minimum in-stream flow criteria, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions. Water conveyance operational criteria are discussed in detail in Section 3.6.4.

As shown in Table 3-4, Alternative 1C would have the same water conveyance facility components as Alternative 1A, except that the primary conveyance would be a lined or unlined canal rather than pipelines/tunnels in the west Delta, the five intakes and associated intake facilities (e.g., sedimentation basins, solids handling facilities, intake pumping plants and associated pipelines) would be located on the west bank of the Sacramento River, and there would be no Intermediate Forebay. Additionally, Alternative 1B would include the following new water facility components.

- Conveyance pipelines between transition structures and canal transition structures with radial gates and stop logs.
- Lined or unlined canal between the intake pumping plants and an Intermediate Pumping Plant.
- An Intermediate Pumping Plant at the entrance of a tunnel would convey diverted water through the tunnel.
- A dual-bore tunnel extending 17 miles between the Intermediate Pumping Plant and a second canal segment.
- A lined or unlined canal between the tunnel exit portal and Byron Tract Forebay.

- Byron Tract Forebay adjacent to and north of Clifton Court Forebay.
- Connections to the Banks Pumping Plant and Jones Pumping Plant, including a canal between Byron Tract Forebay and the approach canals to the Banks and Jones Pumping Plants, and sets of gates in the approach canals upstream of the connection to the canal from Byron Tract Forebay.
- Eight inverted culvert siphons along the conveyance alignment to convey diverted water under ten existing shallow watercourses and one rail line.
- Sixteen bridge crossings along the conveyance alignment.
- Other road and utility crossings, including drainage and irrigation facilities.

An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes, etc.) is presented in Table 3-7. Detailed discussions of water facilities components, including construction detail, are provided in Sections 3.6.1 (Appendix __).

Table 3-7. Summary of West Conveyance Physical Characteristics

Feature Description / Acreage[a]	Approximate Characteristics
Overall project / 9,400	
Potential export capacity (cfs)	15,000
Overall length (miles)	52
Intake facilities / 1,200 (Sacramento River)	
Number of on-bank screened intakes	5
Flow capacity at each intake (cfs)	3,000
Intake pumping plants / (included with intake facilities)	
One pumping plant with sedimentation basin per intake (each)	5
Six pumps per intake plus one spare, capacity per pump (cfs)	500
Total dynamic head (ft)	26-30
Total electric load (MW)	40 MW
Isolated conveyance canals / 4,400	
Type	Unlined or lined
Top width (approximate maximum, ft)	700 (location-specific)
Invert width (ft)	340
Depth (bottom to water surface)	23.5
Side slopes (H:V)	3:1, 8:1
Average permanent ROW width (ft)	1,400
26- by 26-foot culvert siphons / 600	
Elk Slough, length (ft)	1,300
Duck Slough, length (ft)	1,300
Miner Slough, length (ft)	2,000
Rock Slough, length (ft)	2,000
BNSF Railroad, length (ft)	1,880
Main Canal, length (ft)	1,400
Kellogg Creek, length (ft)	1,380

Feature Description / Acreage[a]	Approximate Characteristics
Kendall Creek Overflow, length (ft)	1,730
Italian Slough, length (ft)	1,600
Intermediate pumping plant / 100	
Number of pumps, capacity per pump (cfs)	15 at 1,000 2 at 500
Total dynamic head (ft)	55
Total electric load (MW)	83 MW
Concrete-lined soft ground tunnel—Ryer Island to Contra Costa County (East of Oakley) / 2,300	
Tunnel length (ft)	89,000
Number of tunnel bores	2
Tunnel finished inside diameter (ft)	33
Byron Tract Forebay / 800	
Type	Unlined
Water surface area (acres)	630
Active storage volume (af)	4,300
Power requirements	
Total conveyance electric load (MW)	132 MW

af = acre-feet
BNSF = Burlington Northern and Santa Fe Railroad
cfs = cubic feet per second
ft = feet/foot
H:V = horizontal to vertical ratio
MW = megawatt

[a] Acreage is for permanent facilities and associated temporary disturbance. Overall acreage includes all facilities such as bridge abutments not otherwise listed.

3.5.4.2 Conservation Components

Conservation components under Alternative 1C would be identical to those under Alternative 1A.

3.5.5 Alternative 2A—Dual Conveyance with Tunnel and Five Intakes

3.5.5.1 Physical and Operational Components

Like Alternative 1A, Alternative 2A would consist of pipelines and tunnels generally located in the central Delta with an Intermediate Forebay. This alternative would convey water from five intakes between Clarksburg and Walnut Grove, of which two would be downstream of Sutter and Steamboat Sloughs, to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities at Clifton Court Forebay and Jones Pumping Plant would continue. A map and schematic depicting the conveyance facilities associated with Alternative 2A are provided in Figures 3-2 and 3-3; the alternative's characteristics are summarized in Table 3-1 (the draft map and original schematic for Alternative 2A is the same as that for Alternative 1A).

This facility could convey up to 15,000 cfs from the north Delta. Alternative 2A water conveyance operational criteria would be modified from those described under Alternatives 1A, 1B, and 1C. The modifications are summarized as Scenario B and include incorporation of Fall X2 guidelines and more restrictive south Delta OMR flows, as described in Section 3.6.4.2. The Scenario also includes north Delta diversion bypass flow criteria, South Delta Export/Inflow Ratio, flow criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, Delta Cross Channel gate operations, Rio Vista minimum instream flow criteria, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions.

Alternative 2A would include the same physical/structural components as Alternative 1A, but could potentially entail two different intake and intake pumping plant locations. Currently, intake locations 1–3 and either 4 and 5 or 6 and 7 are being considered. Additionally, some of the conveyance pipelines and the initial tunnel between the intake pumping plants and the Intermediate Forebay would be adjusted depending on the intake locations. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.5.2 Conservation Components

Conservation components under Alternative 2A would be the same as those under Alternative 1A.

3.5.6 Alternative 2B—Dual Conveyance with East Canal and Five Intakes

3.5.6.1 Physical and Operational Components

Alternative 2B would include the same physical/structural water conveyance components and eastern alignment as Alternative 1B, but, like Alternative 2A, could entail two different intake and intake pumping plant locations. Currently, intake locations 1–3 and either 4 and 5 or 6 and 7 are being considered. Proposed water supply operations under Alternative 2B would follow operational Scenario B, and could convey up to 15,000 cfs from the north Delta.

A map and schematic depicting the conveyance facilities associated with Alternative 2A are provided in Figures 3-4 and 3-5 (the draft map and original schematic for Alternative 2B is the same as that for Alternative 1B); characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes,) is presented in Table 3-6. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.6.2 Conservation Components

Conservation components under Alternative 2B would be the same as those under Alternative 1A.

3.5.7 Alternative 2C— Dual Conveyance with West Canal and Five Intakes

3.5.7.1 Physical and Operational Components

Alternative 2C would include the same physical/structural water conveyance components and western alignment as Alternative 1C, but, Alternatives 2A and 2B, could entail two different intake and intake pumping plant locations. Proposed water supply operations under Alternative 2C would follow operational Scenario B, and could convey up to 15,000 cfs from the north Delta.

A map and schematic depicting the conveyance facilities associated with Alternative 2A are provided in Figures 3-6 and 3-7 (the draft map and original schematic for Alternative 2C is the same as that for Alternative 1C); characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.7.2 Conservation Components

Conservation components under Alternative 2C would be the same as those under Alternative 1A.

3.5.8 Alternative 3—Dual Conveyance with Intakes 1 and 2

3.5.8.1 Physical and Operational Components

Alternative 3 would include pipelines and tunnels with an Intermediate Forebay. Alternative 3 would comprise physical/structural components similar to those under Alternative 1A, but would entail only two intakes and intake pumping plants. Conveyance pipelines and the initial tunnel between the intake pumping plants and the Intermediate Forebay would be adjusted to the intake locations. Water would be conveyed from two intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant would continue.

A map and schematic depicting the conveyance facilities associated with Alternative 3 are provided in Figures 3-2 and 3-8 (the draft map for Alternative 3 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

Water supply operations would be guided by criteria under Scenario A (Table 3-1), except that this Alternative would convey up to 6,000 cfs rather than 15,000 cfs from the north Delta.

3.5.8.2 Conservation Components

Conservation components under Alternative 3 would be the same as those under Alternative 1A.

3.5.9 Alternative 4—Dual Conveyance with Intakes 1–3

3.5.9.1 Physical and Operational Components

Alternative 4 would include pipelines and tunnels with an intermediate forebay. Water would be conveyed from three intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant would continue. A map and schematic depicting the conveyance facilities associated with Alternative 4 are provided in Figures 3-2 and 3-9 (the draft map for Alternative 4 is identical to the map of Alternative 1A) ; characteristics of this alternative are summarized in Table 3-1. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

This alternative could convey up to 9,000 cfs from the north Delta. Water conveyance operational criteria would be the based upon the parameters identified in Scenario B. Alternative 4 would comprise similar physical/structural components similar to those under Alternative 1A, but only three intakes and intake pumping plants would be constructed. Conveyance pipelines and the initial tunnel between the intake pumping plants and the Intermediate Forebay would be adjusted to the intake locations.

3.5.9.2 Conservation Components

Conservation components under Alternative 4 would be the same as those under Alternative 1A.

3.5.10 Alternative 5—Dual Conveyance with 3,000 cfs Diversion

3.5.10.1 Physical and Operational Components

Alternative 5 would include pipelines and tunnels with an Intermediate Forebay. Water would be conveyed from one 3,000 cfs intake between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant would continue. A map and schematic depicting the conveyance facilities associated with Alternative 5 are provided in Figures 3-2 and 3-10 (the draft map for Alternative 5 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1.

Water supply operations could convey up to 3,000 cfs from the north Delta. Alternative 5 water conveyance operational criteria are guided by criteria described in operational Scenario C. These operations emphasize Fall X2, south Delta OMR flows, and San Joaquin Export/Inflow ratios.

Alternative 5 would include physical/structural components similar to those under Alternative 1A, but only one intake and intake pumping plant. Conveyance pipelines and the initial tunnel between the intake pumping plants and the Intermediate Forebay would be adjusted to the intake location. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes, etc.) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.10.2 Conservation Components

Conservation components under Alternative 5 would be the same as those under Alternative 1A, except that 25,000 rather than 65,000 acres of tidal habitat would be restored.

3.5.11 Alternative 6A—Isolated Conveyance with Pipeline and Intakes 1–5

3.5.11.1 Physical and Operational Components

Like Alternative 1A, Alternative 6A would convey water from five intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through tunnels to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an "isolated" conveyance— no longer involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant. A map and schematic depicting the conveyance facilities associated with Alternative 6A are provided in Figures 3-2 and 3-11 (the draft map for Alternative 6A is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1.

The proposed water operations under Alternative 6A would discontinue use of the SWP and CVP south Delta export facilities and convey up to 15,000 cfs from the north Delta using proposed water operations described by Scenario D.

Under Alternative 6A, physical and structural components would be similar to those under Alternative 1A. However, existing connections between the SWP and CVP south Delta export facilities would be severed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.11.2 Conservation Components

Conservation components under Alternative 6A would be the same as those under Alternative 1A.

3.5.12 Alternative 6B—Isolated Conveyance with East Canal and Intakes 1–5

3.5.12.1 Physical and Operational Components

Like Alternative 1B, Alternative 6B would convey water from five intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through lined or unlined canals to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an "isolated" conveyance— no longer involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant. A map and schematic depicting the conveyance facilities associated with Alternative 6B are provided in Figures 3-4 and 3-12 (the draft map for Alternative 6B is identical to the map of Alternative 1B); characteristics of this alternative are summarized in Table 3-1.

The proposed water conveyance operations of Alternative 6B would be those described as Scenario D. Water supply operations could convey up to 15,000 cfs from the north Delta.

Under Alternative 6B, physical and structural components would be similar to those under Alternative 1B. However, existing connections between the SWP and CVP south Delta export facilities would be severed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-6. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.12.2 Conservation Components

Conservation components under Alternative 6B would be the same as those under Alternative 1A.

3.5.13 Alternative 6C—Isolated Conveyance with West Canal and Intakes W1–W5

3.5.13.1 Physical and Operational Components

Like Alternative 1C, Alternative 6C would convey water from five intakes in the Sacramento River between Clarksburg and Walnut Grove in the north Delta through a tunnel and two large canal segments to a new Byron Tract Forebay adjacent to Clifton Court Forebay in the south Delta. However, this would be an "isolated" conveyance—no longer involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant. A map and schematic depicting the conveyance facilities associated with Alternative 6C are provided in Figures 3-6 and 3-13 (the draft map for Alternative 6C is identical to the map of Alternative 1C).

The proposed water operations under Alternative 6C would be guided by the parameters identified in Scenario D. Water supply operations could convey up to 15,000 cfs from the north Delta.

Under Alternative 6C, physical and structural components would be similar to those under Alternative 1C. However, existing connections between the SWP and CVP south Delta export facilities would be severed. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-7. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.13.2 Conservation Components

Conservation components under Alternative 6C would be the same as those under Alternative 1A.

3.5.14 Alternative 7—Dual Conveyance with Intakes 2, 3, and 5 and Enhanced Aquatic Conservation

3.5.14.1 Physical and Operational Components

Alternative 7 would include pipelines and tunnels with an Intermediate Forebay. Water would be conveyed from three intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities for Clifton Court Forebay and Jones Pumping Plant would continue. A map and schematic depicting the conveyance facilities associated with Alternative 7 are provided in Figures 3-2 and 3-9 (the schematic for Alternative 7 would be the same as that for Alternative 4 and the draft map for Alternative 7 is identical to the map of Alternative 1A) ; characteristics of this alternative are summarized in Table 3-1.

The water supply operations could convey up to 9,000 cfs from the north Delta. Alternative 7 water conveyance operational criteria are modified from those outlined under Alternatives 1A, 1B, and 1C and are described by operational Scenario E(Table 3-1). The modifications under this enhanced aquatic alternative are intended to further improve fish and wildlife habitat, especially along the San Joaquin River.

Alternative 7 would include physical/structural components similar to those under Alternative 1A, but only three intakes and intake pumping plants would be constructed. Conveyance pipelines and the initial tunnel between the intake pumping plants and the intermediate forebay would be adjusted to the intake locations. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.14.2 Conservation Components

Conservation components under Alternative 7 would be similar to those under Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be restored.

3.5.15 Alternative 8—Dual Conveyance with Increased Delta Outflow

3.5.15.1 Physical and Operational Components

Alternative 8 would include pipelines and tunnels with an Intermediate Forebay. Water would be conveyed from three intakes between Clarksburg and Walnut Grove to a new Byron Tract Forebay adjacent to Clifton Court Forebay. Use of existing SWP and CVP south Delta export facilities at Clifton Court Forebay and Jones Pumping Plant would continue. The water operations could convey up to 9,000 cfs from the north Delta and would be designed to provide up to 1.5 million acre-feet (maf) in increased Delta outflow. Additionally, conservation activities could be enhanced under this alternative. A map and schematic depicting the conveyance facilities associated with Alternative 8 are provided in Figures 3-2 and 3-9 (the schematic for Alternative 8 would be the same as that for Alternative 4 and the draft map for Alternative 8 is identical to the map of Alternative 1A); characteristics of this alternative are summarized in Table 3-1.

Alternative 8 water conveyance operational criteria are under development and will be described by operational Scneario F. The goal is to provide an increased Delta outflow of up to 1.5 maf utilizing SWP and CVP water rights.

Alternative 8 would include physical/structural components similar to those under Alternative 1A, but only three intakes and intake pumping plants would be constructed. Conveyance pipelines and the initial tunnel between the intake pumping plants and the Intermediate Forebay would be adjusted to the intake locations. An overview of the proposed water conveyance features and characteristics (e.g., lengths, volumes, etc.) is presented in Table 3-5. Detailed discussions of water facilities components, including construction detail, are provided in Section 3.6.1 (Appendix __).

3.5.15.2 Conservation Components

Conservation components under Alternative 8 would be the same as those under Alternative 1A, but they may result in different acreages of restored, protected, and enhanced habitat.

3.5.16 Alternative 9—Separate Corridors

3.5.16.1 Physical and Operational Components

Alternative 9, the separate corridors alternative, includes changes to SWP and CVP water conveyance infrastructure and operations, as well as habitat conservation, measures related to reducing other stressors, monitoring, research, and an adaptive management program, as described in detail in Section 3.6.2 (Appendix __).

Under Alternative 9, two fish-screened intakes would be constructed: one each at the Delta Cross Channel and Georgiana Slough. The intakes would be divided into bays to support consistent diversion capacity across the intake. Water would travel through a flow collection channel and radial gates, eventually reaching the existing channel. Once in the channel, water would flow south through the Mokelumne River and San Joaquin River to Middle River and Victoria Canal, which would be dredged to accommodate increased volumes of water. Along the way, diverted water would be guided by operable barriers. Water flowing through Victoria Canal would lead into two new canal segments and pass under two existing watercourses through culvert siphons, eventually reaching Clifton Court Forebay. From there, water would flow through existing SWP facilities, and a new intertie canal would be constructed to connect the forebay to CVP facilities. A map and schematics depicting the conveyance facilities associated with Alternative 9 are provided in Figures 3-14, 3-15, and 3-16; characteristics of this alternative are summarized in Table 3-1.

The water supply operations of this conveyance facility could convey up to 15,000 cfs from the north Delta. Water conveyance operational criteria under Alternative 9 would be guided by criteria identified in Scenario G.

Alternative 9 includes the following water conveyance-related facilities.

- Operable barriers on the Mokelumne River near Lost Slough and on Snodgrass Slough near the Mokelumne River, extension of Meadow Slough to the Sacramento River, and installation of an operable barrier on Meadow Slough. These facilities would provide a path for fish migration from the Mokelumne and Cosumnes Rivers through Lost Slough and Meadows Slough to the Sacramento River except during flood flows.
- On-bank diversions with fish screens at Delta Cross Channel and Georgiana Slough.
- A boat lock and channel at the diversion structure at Georgiana Slough.
- An operable barrier at Threemile Slough to reduce salinity in the San Joaquin River during low Delta outflow and potentially to reduce fish movement from the Sacramento River to the San Joaquin River.
- Operable barriers along Middle River at Connection Slough, Railroad Cut, Woodward Canal, and immediately downstream of Victoria Canal to isolate the south Delta separate water supply corridor from Old River.

- Dredging along Middle River (Mildred River to Victoria Canal) and Victoria Canal to provide for gravity flow into Clifton Court Forebay.
- Expansion and extension of Victoria Canal under West Canal, across Coney Island, and under Old River to Clifton Court Forebay.
- Intertie canal with a control gate between Clifton Court Forebay and the Tracy Fish Facility.
- Closure of the Clifton Court Forebay inlet gate from Old River except during flood flows.
- Closure of channel between Old River and the Tracy Fish Facility except during flood flows. Closure would include channel modification to allow continued access to River's End Marina from Old River.
- Operable barriers along the San Joaquin separate fish movement corridor at the upstream confluence of Old River and the San Joaquin River (Head of Old River), Fisherman's Cut at False River, and Franks Tract to isolate Old River (San Joaquin separate fish movement corridor) from the San Joaquin River.
- A pumping plant on the San Joaquin River at the Head of Old River to convey additional flows with organic material into Old River.
- A pumping plant on Middle River upstream of Victoria Canal to convey additional flows with lower salinity than Old River into Old River.

An overview of conveyance features and characteristics (e.g., lengths, volumes) is presented in Table 3-8.

Table 3-8. Summary of Separate Corridors Conveyance Physical Characteristics

Feature Description	Characteristics
Overall project	
Export capacity (cfs)	15,000
Water supply corridor from DCC to CCF overall length (miles)	35
Intake facilities (Sacramento River)	
Number of fish-screened intakes	2
Flow capacity at each intake (cfs)	7,500
Screen length at each intake (feet)	2,800
Screen height (ft)	15
Operable barriers	
Mokelumne River system	
Mokelumne River near Lost Slough	Type I[a]
Meadows Slough near Sacramento River	Type II[a]
Snodgrass Slough north of Delta Cross Channel	Type I[a]
Sacramento River system	
Delta Cross Channel	Type II[a]
Georgiana Slough	Type II[a]
Three Mile Slough	Type II[a]
South of San Joaquin River	
San Joaquin River at head of Old River	Type I[a]

Feature Description	Characteristics
Middle River south of Victoria Canal	Type I[a]
Victoria Canal / North Canal	Type III[a]
Woodward Canal / North Victoria Canal	Type III[a]
Railroad Cut	Type III[a]
Connection Slough	Type III[a]
Franks Tract	Type III[a]
Fisherman's Cut	Type III[a]
Channel Enlargement	
Middle River, between Mildred Island and Railroad Cut (enlarged area, sq. feet)	4,777
Middle River, between Railroad Cut and Woodward Canal (enlarged area, sq. feet)	4,319
Middle River, between Woodward Canal and Victoria Canal (enlarged area, sq. feet)	3,201
Victoria Canal (enlarged area, sq. feet)	8,145
Culvert Siphons	
Old River (4 Barrels), length (feet)	1,177
"West" Canal (4 Barrels), length (feet)	595
Canal	
Total length of new canal (miles), Coney Island Canal, and CCF Intertie Canal	1.5
Levees	
Total length of new levees constructed near River's End Marina (miles)	1.1
Old River and Middle River diversion pumping plants	
Number of diversion pumping plants	2
Total pumping capacity at each pumping plant (cfs)	250
Three pumps per pumping plant plus one spare, capacity per pump (cfs)	83
Drive type	CS
Total dynamic head at Old River diversion pumping plant (feet)	30
Total dynamic head at Middle River diversion pumping plant (feet)	20
Total electric load at Old River diversion pumping plant (MW)	2.6
Total electric load at Middle River diversion pumping plant (MW)	2.3
Power requirements	
Total option electric load (MW)	7.2

CCF = Clifton Court Forebay
cfs = cubic feet per second
cy = cubic yard
DCC = Delta Cross Channel
feet$_{2}$ = square feet
H:V = horizontal to vertical ratio
MW = megawatt
MDC = Through-Delta Facility
CS = Constant Speed
[a] Type I: Obermeyer Gate, full waterway width;
Type II: Selected from Radial, Miter or Wicket Gates, full waterway width;
Type III: Obermeyer Gate Boat Lock with Rock wall.

3.5.16.2 Conservation Components

Conservation components under Alternative 9 would be similar to those under Alternative 1A, but with changes in the south Delta to accommodate the modified corridors.

3.6 Components of the Alternatives: Details

This section describes the components of all the alternatives (except the No Action Alternative): the location, configuration, and construction of water facilities components; the specific guidelines for water conveyance operational components; the general location, character, and management of conservation activities; and the implementation strategies for components related to reducing other stressors. [*Note to reviewers: Section 3.6 and all its subcomponents is presented here for completeness purposes but can be transferred into an appendix if appropriate*]

3.6.1 Water Facilities Components (CM1)

The permanent and temporary physical/structural components related to water conveyance would vary with alternative. During construction, temporary work areas and facilities throughout the Delta would be needed to construct the project. Temporary facilities would be removed following construction, and the work areas would be returned to their preproject condition. The major components of CM1, both permanent and temporary, are listed below; detailed descriptions follow.

- North Delta Intakes
    - Concrete intake structure
    - Fish screens
    - Sedimentation basin
    - Solids lagoon
    - Intake pumping plant
    - Intake pipelines
    - New access roads
    - New levee/levee modifications
    - Parking, lighting, fencing, and landscaping
    - New utility corridors
- Conveyance Facilities
    - Pipelines/tunnels
        - Pipelines
        - Permanent right-of-way (ROW)/subsurface easements
        - Ventilation/access shafts
        - Temporary precast segment plant during construction
        - Tunnel muck storage/disposal areas

- Canals
  - Canal
  - Culvert siphons
  - Intermediate pumping plant
  - Concrete-lined soft ground tunnel
  - Tunnel siphons
  - New bridges
  - New access roads
- Operable Barriers
- Forebays
  - Intermediate Forebay, embankment, and pumping plant
  - Byron Tract Forebay
  - Gate control structures
  - New utility corridors
  - New bridges
  - New access roads
- Connections to Banks and Jones Pumping Plants
- Power supply and grid connections
- Separate corridors conveyance —levee construction and modification
  - Screened intakes (without pumping plants)
  - Diversion pumping plants
  - Operable barriers (some with boat locks)
  - Fixed barriers
  - New access roads
  - New utility corridors
  - New levee sections
- Temporary access and work areas for intake, canal, and pipeline/tunnel construction
  - Temporary barge unloading facilities
  - Road haul routes and temporary access roads
  - Concrete batch plants and fuel stations
  - General construction work areas

Restoration and stressor reduction measures (CM2 through CM19) could also include physical/structural components related to new roads for site access, levee work, and similar elements. However, these components are analyzed at the program level.

3.6.1.1 North Delta Intakes

Depending on the alternative, CM1 would include construction of up to five new intakes on the east or west bank of the Sacramento River. A total of 17 potential intake locations have been identified, based on discussions with the lead agencies on specific fishery considerations as described in the Fish Facility Technical Team (FFTT) Report[1]. Of these, 12 sites are located along State Route (SR) 160/River Road on the east bank of the Sacramento River from south of Freeport to the historical community of Vorden, and 5 sites are located on the west bank from the Pocket Area to south Merritt Island. These locations were selected to minimize the influence of tidal action, minimize the presence of delta smelt, maintain a separation distance between intakes, and minimize effects on existing communities. A maximum of five intake sites would be selected for any given alternative; each intake would divert a maximum of 3,000 cfs from the Sacramento River.

Each intake site would comprise a concrete structure, fish screens, a sedimentation basin, a solids lagoon, a pumping plant, conveyance pipelines to a point of discharge into the conveyance facility (pipelines/tunnels or canals, depending on the alternative), a 69 kV substation, new access roads and realignment of existing roadways, employee parking, lighting, fencing, and landscaping. A new setback levee (ring levee) would be constructed, and the space enclosed by the existing levee and new setback levee would be backfilled up to the elevation of the top of the setback levee, creating a building pad for the intake structure and adjacent pumping plant.

A conceptual rendering of the intake design is provided in Figure 3-17.

Two 7,500 cfs intake structures and two pumping plants would be constructed under Alternative 9. These intakes would be located where the Sacramento River meets the Delta Cross Channel and Georgiana Slough; the pumping plants, which include their own small intake structures, would be located on the San Joaquin River at the Head of Old River and on Middle River upstream of Victoria Canal. However, these facilities differ significantly from those that would be incorporated in other alternatives. The differences are noted at the end of each subsection below.

Description

Intake Setback Levee

The intakes would be sited along the existing Sacramento River levee system, requiring reconstruction of levees to provide continued flood management. At each intake pumping plant site, a new setback levee (ring levee) would be constructed. The space enclosed by the setback levee would be filled up to the elevation of the top of the setback levee, creating a building pad for the adjacent pumping plant. The new levees would be designed to provide an adequate Sacramento River channel cross section and to provide the same level of flood protection as the existing levee. Transition levees would be constructed to connect the existing levees to the new setback levees.

A typical new levee would have a broad-based, generally asymmetrical triangular crosssection. The levee height, as measured from the adjacent ground surface on the landside and vertically up to the elevation of the levee crest, would range from approximately 20 to 45 feet to provide adequate freeboard above anticipated water surface elevations. The width of the levee (toe of levee to toe of

[1] BDCP Fish Facilities Technical Team. 2011. Bay Delta Conservation Plan Technical memorandum. July 2011. Access date: September 22, 2011. Available: http://baydeltaconservationplan.com/Libraries/News/Final_FFTT_Tech_Memo_07_15_2011_2.sflb.ashx

levee) would range from approximately 180 to 360 feet. The minimum crest of the levee would be 20 feet; however, in some places it would be larger to accommodate roadways and other features. Cut-off walls would be constructed to avoid seepage, and the minimum slope of levee walls would be three units horizontal to one unit vertical.

Construction of the Georgiana Slough intake for Alternative 9 would require the relocation of a levee and associated road to create space for a boat channel and lock to allow continued boat access between the Sacramento River and Georgiana Slough. Both diversion pumping plants, along with their associated facilities, would be constructed on engineered fill, with a final ground level of approximately 25 feet for the Old River plant and 15 feet for the Middle River plant.

Intake Structure

The intake structure would consist of a reinforced concrete structure subdivided into individual bays that can be isolated and individually managed. Water would be diverted from the river by gravity into the screened bays and routed from each bay through multiple parallel conveyance conduits to a receiving partitioned or channelized sedimentation basin. Each bay would be fitted at opposing faces with screen panels, flow control baffles, and provisions for bulkhead isolation. The bank of vertical stainless steel screen panels with stainless steel wire fabric would prevent impingement and entrainment of fry-sized salmonids and juvenile smelt. The series of self-contained flow control baffle assemblies would be located behind the screens and would uniformly distribute approach velocities at the screen face. Log booms and/or deflector equipment would protect the intakes from debris and other floating objects.

From the river bottom to the top of the structure, the intake structure would be approximately 55 feet tall, with the top deck elevation aligning with the top of the adjacent levee to maintain flood protection and provide access. Depending on the height of the river at the intake location, the intake would rise above the river's surface by 20–30 feet. Some intakes would require a surge tower in lieu of an air vent; the elevation of the top rim of the surge shafts would be 70 feet.

The intakes would be sized to provide screen area, in accordance with federal and state standards, sufficient to prevent entrainment and impingement of salmonids and smelt. For the purposes of this EIR/EIS, it is assumed that the fish screens would be designed to meet delta smelt criteria, which require 5 square feet/cfs. Intake structure length would vary by site but would generally range from 900 to 1,600 feet. It is anticipated that the screen cleaning system would include several traveling brush cleaning systems installed on the waterside of the intake. As an alternative to the fixed screen panel and brushing system, a traveling screen system with a screen belt and stationary brush/water jet system could be employed.

The two intake structures for Alternative 9 would not divert water toward a pumping plant but into existing channels. These structures would be 2,800 feet wide and 15 feet high. Each intake would divert up to 7,500 cfs. Radial gates downstream of the intakes would limit flow to this maximum, while slide gates on each bay would equalize approach velocity across the face of the fish screen. The intake at Georgiana Slough would entail construction of a boat lock to allow continued passage between the slough and the Sacramento River. Two smaller intake structures would not include fish screens; these would divert up to 250 cfs into the diversion pumping plants, redirecting flows of existing channels, and would include automatic self-cleaning trash racks, along with sluice gates between the intake and the pumps.

Sedimentation Basins and Solids Handling Facilities

Although the intake fish screens would remove debris and sediment from the intake inflow, to remove the suspended solids that pass through the screen, a sedimentation basin would be constructed between the intake structure and the pumping plant. Settled sediment in the sedimentation basin would be collected by solids collection equipment in the sedimentation basin, and conveyed by positive displacement/progressive cavity pumps to up to three solids lagoons for further settling and disposal. Clarified water would be conveyed from the solids lagoons by gravity to the inlet structure of the sedimentation basin.

The sedimentation basin would be approximately 120 feet long by 40 feet wide by 55 feet deep, and would have interior concrete walls to create separate sedimentation channels, each sized to accommodate the width of one suction bay. The structural system for the basins would consist of reinforced concrete walls and mat slab foundation supported on piles. The walls would be designed to retain external soil loads and contain internal hydrostatic and dynamic loads. The bottom of the basin would be at an elevation between -28.0 and -20.9 feet (NAVD88) and the top of the walls would be at the flood protection elevation.

The solids lagoons would be concrete lined to prevent seepage to the groundwater or adjacent riverbed, would be approximately 10 feet deep, and would have sloped sides with a top width of 86 feet and a top length of 165 feet. Up to three solids lagoons would be used in a rotating cycle with one basin filling, one settling, and the third being emptied of settled and dewatered solids. The volume of solids generated on a daily basis would depend on the volume of water pumped through the intakes, as well as the sediment load within the river. It is anticipated that during most periods when five intakes are operating at about 3,000 cfs, approximately 137,000 dry pounds of solids per day would be pumped to the solids lagoons. During periods of high sediment load in the Sacramento River, the daily mass of solids would be expected to increase up to 253,000 dry pounds per day. The annual volume of solids is anticipated to be 486,000 cubic feet (dry solids basis).

Intake structures built as part of Alternative 9 would not require sedimentation basins or solids lagoons.

Intake Pumping Plant and Facilities

All pumping plants would include a cast-in-place- (CIP-) reinforced concrete structure and a superstructure, a 230 kV power substation and transformer to supply power, an access road, flood protection embankments, parking, outdoor lighting, security fencing, and communication equipment. In addition, intake pumping plants would have concrete sedimentation basins and associated solids handling facilities, and conveyance piping to a point of discharge into the proposed conveyance structure (i.e., pipelines/tunnels or canals). These structures/facilities would be located on the landside of the levee. To protect the structures from flood waters, the sedimentation basins, solids lagoons, and pumping plant would be constructed on engineered fill above design flood condition.

Each of the pumping plant sites would be approximately 1,000 by 1,000 feet (approximately 20 acres). The pumping plant would be approximately 262 feet long by 98 feet wide. Intake pumping plants would be constructed of reinforced concrete and have multiple floors to house mechanical and electrical equipment. The primary structural support systems used for the pumping plants would consist of reinforced concrete slabs and walls at and below grade, with steel framing and exterior metal wall and roof panels for the above-grade building. The pumping plant mechanical building system design criteria would conform to the requirements of Title 24, the California Mechanical Code, and other applicable codes, and would include heating, ventilation, air conditioning, plumbing, and fire protection systems.

The intake pumping plant would include seven 500-cfs pumps, including one standby pump. The intake pumps would be orientated vertically and would operate in parallel. Each pump would discharge into an individual, 96-inch-diameter (8-foot) pipe. Pumping capacity could be varied by reducing the number of pumps on line and/or adjusting the pump operating speed. Variable frequency drives (VFDs) and flow meters would be required on all pumps to vary the pumping rate.

Conceptual engineering indicates that the intake pumping plants would require a pile foundation supporting a common concrete mat. Based on a preliminary pile foundation evaluation, using a 24-inch concrete-filled pipe pile, an estimated pile length of 40–45 feet below the founding level of the intake pumping plant would be required.

A facility control system could provide local and remote automatic and manual control and monitoring of the facilities. It is anticipated that the control system would use a combination of buried fiber optic systems, microwave radio, and leased telecommunications lines. A global positioning satellite (GPS)-based time clock at each pumping plant would support the control system. This equipment would require that a small dish antenna be mounted on the roof of the pumping plant. Two additional antennas would be mounted on the pumping plant at Intake 1 to support a communications system.

A communications system would connect to the existing DWR Delta Field Division Operations and Maintenance Center near Banks Pumping Plant and the DWR communications headquarters in Sacramento. Buried fiber optic conduit would be installed from the southern end of the new conveyance facility at Byron Tract Forebay along the inlet canal to Banks Pumping Plant and the Delta Field Division Operations and Maintenance Center. The conduit route would be adjacent to roads, highways, railroads, utilities, or other easements.

Pumping plants constructed for Alternative 9 would not pump water from intake facilities into other conveyance facilities. Rather, these pumping plants would provide diversion flow into existing channels. Each of the pumps would have three pumps plus one spare and each plant would have a 250 cfs capacity. The San Joaquin River plant would convey additional flows with organic material into Old River. The Middle River plant would convey additional flows with lower salinity levels into Old River. These plant sites include a dewatering sump and discharge piping, flow meter vaults, outfall piping, an electrical and control building, an access road, and a transformer.

Intake Pumping Plant Substation

Each intake pumping plant would be served by a 69 kV substation with a footprint of about 150 by 150 feet. Here, transformers would convert power from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. For Alternatives 1B, 2B, and 6B, one intake pumping plant would also house a 230 kV substation, which would be located in a 268- by 267-foot enclosure. This substation and its transformers would convert power from the project's main 230 kV transmission line to 69 kV, for use by the pumping plants and other facilities.

The substations would be constructed adjacent to the pumping plants on concrete pads with sufficient ground preparation. The substation would be at the same elevation as the pumping plant operating floor and at the flood protection level; excavation is not anticipated.

To supply power during construction of the intake and pumping plant structures and power for the tunneling and excavating machines, substations would be constructed early in the overall construction schedule.

Intakes and pumping plants constructed for Alternative 9 would not necessitate substations but would incorporate transformers.

Fencing, Lighting, and Landscaping

Security fencing and lighting would be installed at all pumping plants. Outdoor lighting fixtures would be luminaries with individual photocells. Critical paths, entrances, and walkways would be illuminated. High bay lighting fixtures would be high-pressure sodium vapor, instant-on lamps.

The need for fencing will be determined in accordance with DWR's WREM No. 41a to protect the public from hazards associated with the project facilities and ensure security of the facilities and operational personnel. Fencing would be placed within the rights of way of the facilities.

Vegetation and signage are to be determined in accordance with DWR's sensitivity to their impact on the Delta environment with guidance given by DWR's WREM No. 30a, *Architectural Motif, State Water Project*. All proposed vegetation and signage will be coordinated with local agencies through an architectural review process.

Intake Access

The intakes would all be sited on the existing Sacramento River levee and levee roads. The intake design includes parking for employees during operations and maintenance. Along with the levee modifications discussed above, the levee roads would need to be realigned. Temporary access roads would be needed to connect the existing road network to the intake site for delivery of materials and construction equipment and personnel. Temporary access roads around the building site would also be necessary during construction. The existing levee roads are public roads that carry traffic through the Delta, and include SR 160 and various county roads. Access for travelers through the Delta on these existing roadways would be maintained by use of temporary new road detours around the intake sites. The existing alignment of these roadways would be modified to accommodate the intake structure, and the roadways would be reopened to traffic following construction.

Operations and Maintenance

The proposed intake facilities would require routine or periodic adjustment and tuning to remain consistent with design intentions. Facility maintenance would consist of activities such as painting, cleaning, repairs, and other routine tasks to operate facilities in accordance with design standards after construction and commissioning.

Routine visual inspection of the facilities would be conducted to monitor performance and prevent mechanical and structural failures of project elements. Maintenance activities associated with river intakes could include removal of sediments, debris, and biofouling materials. These maintenance actions could require suction dredging or mechanical excavation around intake structures; dewatering; or use of underwater diving crews, boom trucks or rubber wheel cranes, and raft- or barge-mounted equipment.

Construction

Depending on foundation material, foundation improvements would require excavation and replacement of soil below the new levee footprint and potential ground improvement. Excavation would typically replace native soils with imported soils to a depth of 5 feet, while a zone of improved foundation materials would be created from a combination of existing and added materials mixed together and applied to depths of 20–60 feet. Excavated materials would be exported offsite. The levees would be armored with riprap—small to large angular boulders—on the waterside.

Intakes could be constructed using one of two methods, depending on the extent of levee modifications to avoid modification of flood water elevation. One method would involve construction of a cofferdam in the river, creating a dewatered construction area that would encompass the intake site. Minor channel work would also be necessary to install the intake fish screens. The other method would involve construction of a cofferdam on the landside of the existing levee and construction of a new levee to the landside of the intake structure. For the purposes of this EIR/EIS, it is assumed that the first method would be employed for each intake. A cofferdam would be required for intake construction. The cofferdam would be anchored to the existing or new levee upstream and downstream of the intake location. Each cofferdam would be approximately 1,000 feet long and 30 feet wide and would be constructed with sheet piles driven with an impact hammer from a barge- or deck-mounted pile-driving rig.

The piles would be driven within the allowable windows for in-river construction. Following completion, an in-river cofferdam would be dewatered using dewatering wells. Dewatering pumping would occur 24 hours per day, 7 days per week, and would continue throughout intake construction, pumping water from the cofferdam to tanks on the landside of the adjacent levee. Water would be treated and could be used for dust control, with the remaining flows returned to the Sacramento River. Prior to dewatering, a fish rescue plan (discussedin Appendix __, *Environmental Commitments*) would be implemented, as necessary, for dewatering operations.

An area may be excavated adjacent to the intake structure to facilitate sediment removal during facility operations. This area would be graded to provide a relatively smooth surface, which would exclude rocks, vegetation, and debris. The size of the area would depend on the specific intake site, but for the purposes of this EIR/EIS, it is assumed that the area would extend approximately 750 feet upstream and downstream of the intake structure and approximately 250 feet away from the longitudinal sides of the intake structure.

Depending on the depth at which the conduits are installed, construction could involve micro tunneling or open-cut trenching. If micro tunneling is employed, conduits would be constructed from inside the cofferdam to the landside of the levee prior to construction of the intake. Muck from micro tunneling would be removed using conveyors or pumps and transferred to a separation plant to remove the suspended solids from the soil cuttings of the muck. The muck would be treated, drained, and transported to stockpiles consistent with the NPDES permit requirements.

If open-cut trenching is used and the native materials are generally of good quality in the area of conduit construction, excavated material from the trench would be used as embedment and backfill materials. Excess material would be exported offsite. If the native soils are not suitable as foundation materials for the trench, those materials would be imported to the site.

3.6.1.2 Conveyance Facilities

Tunnels

Design

The tunnel conveyance would consist of a single bore 29-foot inside diameter (ID) tunnel on the northern end of the project and a two-bore, 33-foot ID tunnel on the longer, southern end of the project. An Intermediate Forebay would be constructed to provide a hydraulic break before the diverted water enters the common tunnel conveyance system downstream. This hydraulic break would provide water conveyance operational flexibility and allow independent operation of each intake facility.

The tunnel system would be operated under pressurized conditions as a constant volume with isolation facilities to allow reducing the number of tunnels in operation during periods of lower flow and maintain velocity in active tunnels.

In alluvial soils with high groundwater pressures, the tunnel would be constructed at depths greater than 60 feet using mechanized closed-face pressurized tunneling machines. The tunnel invert elevation is assumed to be at 100 feet below mean sea level (msl), primarily to avoid peat deposits. It would be lowered to 160 feet below msl under the San Joaquin River and Stockton Deep Water Ship Channel to maintain sufficient cover between the tunnel and dredging operations in the shipping channel. A minimum horizontal separation of two outside tunnel diameters would be maintained in reaches with two tunnel bores.

The main construction or launching shafts for each tunnel would be about 60 feet in diameter to accommodate construction and construction support operations. The tunnel-boring machine retrieval shaft would be approximately 45 feet in diameter, and 12-foot-diameter intermediate ventilation shafts would be located approximately every 3 miles.

The tunnels would be lined with precast concrete bolted-and-gasketed segments. The tunnel concrete liner would serve as permanent ground support and would be installed immediately behind the tunnel-boring machine, thereby forming a continuous watertight vessel.

Temporary concrete batching plants would be required to produce tunnel segments. The segments could be transported by barge or truck. Manufacturing of the tunnel segments would not necessarily be done at the same plant. It is possible that one plant could serve all of the tunnel reaches. However, for the purposes of this EIR/EIS, the following assumptions were used for analysis.

Refer to Table 3-5 for a description of the physical characteristics of the tunnel conveyance facility (Alternatives 1A, 2A, 3, 4, 5, 6A, 7, and 8). A conceptual drawing of the configuration of a typical tunnel segment is shown in Figure 3-18.

Operation and Maintenance

Maintenance requirements for the tunnels have not yet been finalized. Some of the critical considerations include evaluating whether the tunnels need to be taken out of service for inspection and, if so, how frequently. Typically, new water conveyance tunnels are inspected at least every 10 years for the first 50 years and more frequently thereafter.In addition, the equipment that the facility owner must put into the tunnel for maintenance needs to be assessed so that the size of the tunnel access structures can be defined. Equipment such as trolleys, boats, harnesses, camera equipment, and communication equipment would need to be described prior to finalizing shaft design, as would ventilation requirements.

At the time of preparation of this EIR/EIS, the use of remotely operated vehicles or autonomous underwater vehicles is being considered for routine inspection, reducing the number of dewatering events and reserving such efforts for necessary repairs.

Construction

Construction staging areas would include space for offices, parking, shops, segment storage, fan line storage, daily spoils pile, power supply, water treatment, and other space requirements. Depending on the method selected to construct the walls for the shafts, the staging areas may also include space for the slurry ponds required for slurry wall construction. Work areas for muck handling and permanent spoils disposal would also be necessary.

The proposed tunnels are anticipated to be constructed in soft, alluvial soils with high groundwater pressures. Because of this, the tunnels would be constructed using mechanized soft ground tunneling machines. Each tunnel would require appropriately sized shafts to accommodate equipment. If dense gravels, cobbles, or boulders are encountered in the older alluvium at depth, other mining methods may be utilized, such as grouting, jet grouting, use of a slurry tunnel boring machine, or freezing and hand mining. All shaft locations would be protected against flooding caused by failure of levees.

After construction of the tunnels, the launching and retrieval shafts would be backfilled around steel pipes or formed concrete pipes, or would be cast against reusable forms to the required finished diameter and geometry. The intermediate shafts would be excavated using conventional augers and would be supported using steel casings. The shafts would be drilled to below the tunnel invert elevation before the boring machines reaches the shaft stationing.

The tunnel muck–handling system likely would consist of either muck cars or continuous conveyors with the muck stockpiled at the ground surface and dewatered/dried. The resultant solids would then be transferred to disposal areas by conveyor, wheeled haul equipment, or barges.

Canals

Design

The canal conveyance would consist of a trapezoidal open channel earthen canal formed by embankments constructed of compacted engineered fill. The canal would require new access roads for maintenance, a drainage system to carry surface runoff and floodwater, and irrigation ditches to maintain existing agricultural ditches. Short segments of buried pipeline would also be utilized to convey water from the intake pumping plants to the canal.A new access toe road would be constructed on each side of the canal embankment to provide maintenance access to the drainage and irrigation ditches and to areas otherwise cut off by the canal. The toe road would be paved where existing paved roads have been disrupted by the canal. In other areas where existing roads are gravel or not surfaced, the toe road is assumed to be gravel. The toe road would connect to the embankment maintenance road at locations where the embankment maintenance road is interrupted at the ends of the embankments and at bridges. The toe roads would tie into existing public roads and may or may not be publicly accessible.

In areas where the existing ground slopes toward the canal on both sides, a drainage ditch would be constructed along both sides of the canal to collect water and direct it to collection points for removal by pumping. It is anticipated that these new ditches would be approximately 5 feet deep and would connect to the existing drainage system. In areas where the ground slopes away from the canal on both sides, or if surface runoff would be intercepted and conveyed around the canal by an existing drainage feature, no new drainage areas would be constructed.

The risk to the canal from flooding in the adjacent islands may be reduced by providing a means for drainage water to pass from one side of the canal to the other. The water would be routed by any of the means listed below.

- Under the canal with a culvert to existing drainage systems.
- Over the canal with an overchute to existing drainage systems.
- Around the canal and through a gap between the existing levee and the ends of the canal embankments.
- To new storm drain pumps that would pump the water to sloughs or the canal.

Construction of irrigation ditches to supply water for agricultural use may be required in areas where irrigation water supply ditches are separate from drainage ditches.The irrigation ditches would likely need to be elevated above the existing ground to allow for gravity flow. New pumps or siphons may be required to supply the irrigation ditches.

Inverted culvert siphons would be used to convey diverted water from canals under major waterways and railroads. The 15,000 cfs culvert siphons would consist of reinforced concrete rectangular cells of 26 feet by 26 feet each. Siphon length would vary from 595 feet to 2,400 feet, including concrete portions as well as upstream and downstream transition structures. The water velocity would be approximately 2 feet per second in the canal approaching the culvert siphon and 5–6 feet per second in the culvert. The culvert size and shape were selected as a compromise between head loss and potential sedimentation. The top of the culvert would be located about 15 feet below the lowest elevation of the crossing to prevent exposure due to scour in the water body and to prevent uplift by the groundwater in the vicinity of the crossing.

Control structures would be provided at the inlet to the culvert siphon to allow for regulation of upstream water surface elevation. Control structures would also be provided at intermittent locations along the canal to provide for improved control of the water surface elevations where siphons are not required. For this analysis, it is assumed that radial gates with electric motors would be utilized to provide for control of the water surface elevation within the canal. A conceptual drawing of a typical culvert siphon is shown in Figure 3-19.

Where canals cross significant existing water bodies, tunnels would be used to convey water between canal segments. For the west canal conveyance (Alternatives 1C, 2C, and 6C), a 17-mile-long tunnel segment would convey water from Ryer Island to Hotchkiss Tract. In the east canal conveyance (Alternatives 1B, 2B, and 6B), shorter tunnel siphons would connect canal segments, crossing Lost Slough/Mokelumne River (5,400 feet), San Joaquin River (2,700 feet), and Old River (1,700 feet).

Tables 3-6 and 3-7 present a description of the physical characteristics of the canal conveyance alignments (Alternatives 1B, 2B, and 6B for the east conveyance and Alternatives 1C, 2C, and 6C for the west conveyance). A conceptual drawing of a typical canal segment is shown in Figure 3-20.

Canal segments would also be constructed for Alternative 9. One of these canals would cross Coney Island, connecting an enlarged and realigned Victoria Canal to Clifton Court Forebay, with culvert siphons conveying water under the existing West Canal and Old River. Another canal with a control gate would be constructed to connect Clifton Court Forebay with the Tracy Fish Facility. Together, these canals would stretch about 1.5 miles.

Operation and Maintenance

The flow rate and water level within the canal would be controlled by control structures such as radial gates to divide the canal into pools. Drawdown rates of water within the pools would be determined on the basis of the stability of the conveyance side embankment slopes.

Maintenance requirements for an unlined canal would include control of vegetation and rodents, embankment repairs in the event of flooding and wind wave action, and monitoring of seepage flows.

Sediment would be expected to build up on the bottom of the canal and require periodic removal by dredging. Sediment traps may be constructed to reduce the sediment that would collect in the siphons and tunnels.

Construction

Construction of the canal and pipeline segments connecting the intakes to the canal are assumed to be constructed at approximately 30 foot depths in open trench excavations for the majority of the alignment, except where crossing a major waterway. As discussed above for tunnel construction, major waterways would be crossed via deep tunnel siphons. For the canal, excavation would proceed first with the excavated materials initially being hauled to off site disposal areas or stockpiled nearby. Once a sufficient area has been excavated, the foundation for the embankments would be prepared and the embankments constructed. The canal and embankments would be constructed in independent segments. In addition to excavation for the canal, borrow areas, haul roads at the toe of the embankments, grading for drainage, and drainage pumping stations would be required to construct the canal.

Excavation of unsaturated soils could be performed using scrapers or excavators loading into large dump trucks. Excavations below the groundwater table using the same types of equipment would require extensive dewatering.

Excavated materials that are suitable for embankment fill could be hauled and placed directly into areas ready for embankment construction or stockpiled for future use; unusable material would be hauled to spoils disposal areas.

It is unlikely that excavation of the canal would yield sufficient quantities of suitable material to build the embankments. Therefore, additional embankment material from offsite borrow locations would be needed. The imported embankment materials would be placed and compacted on the dewatered foundation. Moisture conditioning of the embankment materials would generally be performed in the borrow areas prior to hauling and placement in the embankments.

The most likely method for construction of the shallower culvert siphon crossings is a cut-and-cover type excavation. Water in the slough would be diverted by use of a partial cofferdam across the slough (with continuous flow pumping of typical irrigation or flood flows) or by a temporary realignment of the slough during construction.

3.6.1.3 Operable Barriers

Design

Operable barriers would be a primary structure to support water conveyance under Alternative 9. An operable barrier at the Head of Old River would also be constructed to support operations of Alternatives 2A, 2B, 2C, and 4. Under Alternative 9, operable barriers would serve to hydraulically isolate the corridors dedicated to fish movement and estuary habitat from those dedicated to diverting water from the Sacramento River and conveyingit toward existing SWP and CVP facilities in the south Delta. The operable nature of the barriers would allow adjustments to channel flows to correct for changes in water quality and quantity within the Delta. Alternative 9 would use three types of barriers to accomplish different goals: inlet flow control, fish isolation, irrigation level control, flood control, and boat passage.

Depending on the characteristics of a specific barrier site and the intended function of the barrier, a variety of gate styles could be used. Depth of water, differences in water elevation between gate sides, whether the gates would be used to vary flow, and whether gates would permit boat passage are all factors that would determine the gate type(s) selected for any particular barrier. Similarly, the number of gate bays required at any given barrier would depend on the width and bottom profile of the channel.

Each barrier would tie into levees on both sides of the waterway. For those gates providing a flood protection function, the top elevation of the gates and barrier walls would be set to the same elevation as the existing levee crest adjacent to the barrier. Otherwise, gates would be slightly higher than normal waterway flow.

Type I barriers would use bottom-hinged navigable gates in locations where the majority of the waterway width requires gates and where depth is less than 20 feet. Type II barriers involve the use of nonnavigable radial gates for flow control and navigable wicket or miter gates for the operable portions; these would be used where waterway depth exceeds 20 feet. Type III barriers would also use bottom-hinged navigable gates for operable portions (like Type I) but would use a rock wall for the fixed portion. This type of barrier would be used where gates are only required for recreational boat passage and where flood neutrality is not an issue.

Each barrier location would be accompanied by a 15-foot-wide by 53-foot-long control building. For those barriers requiring boat locks, the control building would also include an operations room on a second floor. Each site would also include a ground-mounted transformer and emergency generator.

Table 3-8 lists the operable barrier locations and types for Alternative 9.

Operation and Maintenance

Gates would require routine annual inspection of gate facilities and systems, as well as associated equipment. Some gates may not be required to operate for extended periods of time and would be operated at least two times per year. Each gate bay would be inspected annually at the end of the wet season for sediment accumulation. Sediment would be removed during the summer. Each miter or radial gate bay would include stop log guides and pockets for stop log posts, which would allow the dewatering of individual bays for inspection and maintenance. Major maintenance could require a temporary cofferdam upstream and downstream to facilitate dewatering.

Construction

The construction of operable barriers would require dredging several hundred feet upstream and downstream of gate structures to transition the channel sides to fit the depth and width of the gates. Riprap would then be installed in these areas to control erosion.

Gates for Type I and III barriers could be constructed with existing waterways either wet or dry. Wet construction would require offsite prefabrication with attachment of concrete sills. The site would be dredged and sheet piles and H-piles installed. Then the sills and gates would be lifted into place using either barge-mounted cranes or catamarans made of Flexi-floats. Type II barriers would be constructed during summer low-flow periods. A closed steel sheet pile cofferdam would be constructed across part of the waterway. After dewatering, the structure would be constructed. Then the cofferdam would be removed and a new one installed for construction of the adjacent section. Construction through the winter high-flow periods is not anticipated. Additional temporary cofferdams may also be required upstream and downstream of deeper gate bays to allow dewatering and gate panel installation to take place. Barrier structures for Type II miter gates would include reinforced concrete walls, piers, and foundation mats. For the purposes of this analysis, it is assumed that a 60-ton bearing capacity would guide the depth of pile driving for foundation piles, anticipated to be between 60 and 80 feet below foundation level. A barge-mounted crane would install the rock walls for Type III barriers. The rocks may need a prepared foundation, depending on local site conditions.

A temporary work area of up to 15 acres would be required in the vicinity of each barrier forsuch uses as storage of materials, fabrication of concrete forms or gate panels, stockpiles, office trailers, shops, and construction equipment maintenance.

3.6.1.4 Forebays

Design

Intermediate Forebay and Intermediate Pumping Plant

The Intermediate Forebay would provide storage of approximately 5,250 af with a surface area of 750 acres and would provide a transition between the north Delta intakes and the Intermediate Pumping Plant. The forebay would allow the Intermediate Pumping Plant to operate efficiently over a wide range of flows and hydraulic heads in the pipelines/tunnels. Limitations on delivery of water from the intakes into the Intermediate Forebay and the need to operate the Intermediate Pumping Plant efficiently would limit the ability to deliver flow from the pipelines/tunnels during portions of the day to the existing Banks and Jones pumping plants. For the Banks Pumping Plant, this includes operating at low flows during hours with high electrical costs and at maximum capacity during “off-peak” periods to minimize electrical power costs. The Jones Pumping Plant must operate continuously (i.e., 24 hours per day, 7 days per week). The Byron Tract Forebay (see description below) would alleviate some of the impacts of these operational constraints and provide storage to balance inflow with outflow.

The Intermediate Pumping Plant would include ten 1,500 cfs pumps to be used in higher hydraulic head condition, and six 1,500-cfs pumps for lower hydraulic head conditions. The pumping plant would include an approach channel from the forebay to the pump bays, the pumping plant structure, discharge pipes with flow measurement, transition manifold, and transition pipelines for discharge to the tunnel.

The Intermediate Forebay allows for operation of a gravity bypass of the Intermediate Pumping Plant by balancing the differential hydraulic head between the Intermediate Forebay and the Byron Tract Forebay.

The Intermediate Pumping Plant would be staffed 24 hours each day and would require similar maintenance activities to the intake pumping plants, as described in Section 3.6.1.1. It is assumed that the Intermediate Pumping Plant would require periodic harvesting of pond weeds to maintain flows and forebay capacity. The harvesting would occur in the forebay and at the trashracks immediately upstream of the Intermediate Pumping Plant.

The east and west canal conveyance alignments (Alternatives 1B, 2B, 6B and 1C, 2C, and 6C, respectively) would incorporate a similar Intermediate Pumping Plant. The east alignment plant would be about 3.5 miles south of the point where the alignment crosses the San Joaquin River. The west alignment plant would be at the entrance to the tunnel segment on Ryer Island, approximately 1.2 miles east of the Sacramento River Deep Water Ship Channel. The Intermediate Pumping Plant under these conveyance alignments would provide diverted water with the necessary head to flow into the Byron Tract Forebay.

Byron Tract Forebay

The Byron Tract Forebay (Alternatives 1 through 8) would be adjacent to Clifton Court Forebay and would provide storage of approximately 4,300 af with a surface area of 620 acres. The Byron Tract Forebay would be used to balance variations in pipeline/tunnel inflow with outflow on a daily basis. For the Banks Pumping Plant, this includes operating at low flows during hours with high electrical cost and at maximum capacity during “off-peak” periods to minimize electrical power costs. The Jones Pumping Plant would operate continuously. For Alternatives 1A, 1B, 2A, 2B, 3, 4, 5, 6A, 6B, 7, and 8, the Byron Tract Forebay would be constructed on the southeast side of Clifton Court Forebay. For Alternatives 1C, 2C, and 6C, the Byron Tract Forebay would be constructed on northwest side of Clifton Court Forebay.

Operation and Maintenance

New forebays would be dredged to remove sediment and maintain design capacity. Maintenance requirements for the forebay embankments would include control of vegetation and rodents, embankment repairs in the event of island flooding and wind wave action, and monitoring of seepage flows. Maintenance of control structures could include roller gates, radial gates, and stop logs. Maintenance requirements for the spillway would include the removal and disposal of any debris blocking the outlet culverts. Dredging may be necessary to remove sediments in the forebays. As designed, both forebays are expected to have capacity to store sediment accumulated over a 50-year period. However, depending on the actual sedimentation rate, dredging may be necessary more or less often.

Construction

Approximately 6 million cubic yards of earth would be excavated from portions of the intermediate forebay, and approximately 14 million cubic yards of earth would be excavated from the Bryon Tract Forebay. These excavation amounts include the embankment foundation. Dewatering would be required for excavation operations. Much of the excavated material at both locations is expected to be high in organics and unsuitable for use in embankment construction and would require offsite disposal. Some of the excavated material below the peat layers at both locations may be suitable for use in constructing the embankments. To the extent possible, spoils to be used for the embankments would be stored onsite.

3.6.1.5 Connections to Banks and Jones Pumping Plants

Design

For Alternatives 1A, 1B, 2A, 2B, 3, 4, 5, 6A, 6B, 7, and 8, an approximately 2,000-foot-long canal would be constructed to connect the Byron Tract Forebay with the existing approach canal to the Banks Pumping Plant, with a series of radial gates to isolate the facilities. Under these alternatives, another series of radial gates constructed in an opening in the embankment of Byron Tract Forebay would allow for the control of water flow between the forebay and the approach canal to the Jones Pumping Plant. For Alternatives 1C, 2C, and 6C, a canal would stretch from Byron Tract Forebay to approach canals for both existing pumping plants. The alternatives allowing dual conveyance would also include the construction of gates in the existing approach canals upstream of the connections with the new facilities. These structures would allow operational flexibility between pumping from the north Delta and pumping from the south Delta.

Where the canal water surface elevation is generally above existing ground, the canal would be formed by earth embankments constructed of compacted engineered fill. The crests of the embankments would be wide enough to allow for two maintenance vehicles traveling in opposite directions to pass each other. The canal would be designed with 2 feet of concrete-lined freeboard[2] plus 2 feet of unlined freeboard for a total of 4 feet of freeboard on the waterside. Waterside embankments could include wind and wave erosion control, such as concrete lining, riprap, or lining with articulated concrete mat. This analysis assumes that the canals would not be lined.

Seepage from the canal could occur where the normal water level in the canals is higher than the groundwater levels of the adjacent areas. Seepage could potentially raise the water table on the landside of the embankments through more permeable lenses of sand and and/or gravel in the foundation. Control of seepage could include the following methods.

- Installation of a slurry cutoff wall through the canal embankments and foundation. A cutoff wall would be most effective in areas where a canal cuts through layers of permeable sands and gravels.
- Use of a drainage ditch parallel to a canal to control seepage and groundwater levels. Water in the drainage ditch would then be pumped into the sloughs or back into the canals.
- Installation of pressure relief wells along the drainage ditch to collect subsurface water and direct it into the parallel drainage ditch.

Open channel, gravity flow, concrete flumes (overchutes) that pass runoff over the canals could be utilized where the canals are built into a hillside. Overchutes require piers similar to bridges to support the structure and span the width of the canals. Corrugated metal pipe and steel pipe could be used to convey stormwater runoff from adjacent lands over the canals.

Construction of the canal would disrupt both natural and agricultural drainage patterns along the alignment. If the existing ground slopes toward a canal on both sides, a drainage ditch would be

[2] Vertical distance between the design water surface elevation and the elevation of the bank or levee that contains the water.

constructed along both sides to collect water and direct it to collection points for removal by pumping or discharge to surface waters. The new ditches would be approximately 5 feet deep and would connect to the existing drainage system. In areas where the ground slopes away from a canal on both sides, or if surface runoff would be intercepted and conveyed around a canal by an existing drainage feature, no new drainage areas would be constructed. Drainage water could be routed under a canal in a culvert, over a canal in an overchute, or to a collection basin for conveyance to surface waters by gravity or a pump station.

Roads on each side of the embankments would provide maintenance access and access to areas intercepted by the canal. The roads would be paved where existing paved roads have been disrupted by the canal and would be gravel surfaced in other areas. The roads would connect to the embankment maintenance roads at locations where the embankment maintenance roads are interrupted at the ends of the embankments.

Operations and Maintenance

Maintenance requirements for the canal would include erosion control, control of vegetation and rodents, embankment repairs in the event of island flooding and wind wave action, and monitoring of seepage flows. Sediment traps may be constructed by over-excavating portions of the channel upstream of the structures where the flow rate would be reduced to allow suspended sediment to settle at a controlled location. The sediment traps would be periodically dredged to remove the trapped sediment.

Construction

Canal construction would include use of scrapers, excavators, and /or draglines. The top layer of soil along some portions of the canal could consist of up to 25 feet of organic and peat soils deemed unsuitable for support of the canal embankments. In such areas, these soils would be removed and disposed of offsite. The removal of the full depth of the peat and organic soil could be limited to the area of the embankment foundations. In other areas, potentially liquefiable sands could be present below the organic soils. It would be necessary to remove or stabilize the liquefiable soils as part of the excavation for the canal embankments.

3.6.1.6 Power Supply and Grid Connections

Electric power would be required for intakes, pumping plants, operable barriers, boat locks, and gate control structures throughout the various proposed conveyance alignments. Temporary power is also required during construction of project facilities. The precise alignment of transmission lines and the interconnection point will be based on the selection of a power provider for the project, following selection of a conveyance alignment.

Electrical power for new north Delta pumping plant facilities would be delivered through a single 230 kV transmission line, owned by either the utility or the project, that would interconnect with a local utility at a new or existing utility substation depending on the conveyance alignment. It is assumed that a new substation would be constructed within or adjacent to the utility's existing transmission ROW. Some utility grid reinforcement and upgrade are likely to be needed to accommodate this large new pumping load. The transmission line would terminate at the project's main 230 kV substation, which would be adjacent to one of the new pumping plants within a 268- by 267-foot enclosure. At the project's main 230 kV substation, the electrical power would be transformed from 230 kV to 69 kV and delivered to the adjacent main 69 kV substation to power the adjacent pumping plant. Additionally, the main 69 kV substation would deliver power on a new overhead 69 kV subtransmission line, looping into each of the other intake substations. Each 69 kV substation would have a footprint of approximately 150 by 150 feet. The subtransmission line would generally follow the project ROW. At the main 69 kV substation and at each of the intake substations, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures.

For Alternatives 1B, 1C, 2B, 2C, 6B, and 6C, a main 69 kV substation would be constructed at the Intermediate Pumping Plant, and an overhead 69 kV subtransmission line would be constructed along a route parallel to the canal and within the project ROW. To supply power for communications, monitoring, and control of the gates at the tunnel and siphon entrances along the canal, 12 kV distribution lines would be extended along the canal from the 69 kV substations. Wherever possible, this 12 kV line would be constructed on the same poles as the 69 kV subtransmission line. A local utility distribution line would provide power for gate controls along the south canal of Alternatives 1C, 2C, and 6C. For Alternatives 1A, 2A, 3, 4, 5, 6A, 7, and 8, the main 69 kV substation would be built at the Intermediate Pumping Plant with 69 kV subtransmission lines looping into each intake plant substation and 230 kV lines following the project ROW south toward Byron Tract Forebay.

Two utility grids could supply power to the project: Pacific Gas and Electric Company (PG&E) (under the control of the California Independent System Operator) and the Western Area Power Administration (Western). The electrical power that is needed for the conveyance facilities would be procured in time to support construction and operation of the facilities. As the operator of the State Water Project, DWR is an active participant in the activities of the California electric grid, from long-term planning to day-to-day operation. The DWR Planning and Risk Office will lead the process of identifying, evaluating, and establishing the electrical interconnection of this project to the California electric grid. The power will be provided from the SWP power portfolio of existing physical generation facilities, long-term power contracts, and short-term power contracts—including Day-Ahead market purchases. Purchased energy may be supplied by existing generation, or by new generation constructed to support the overall energy portfolio requirements of the western electric grid. It is unlikely that any new generation will be constructed solely to provide power to the DHCCP Project.

PG&E's distribution system would likely provide power for the separate corridors conveyance alignment (Alternative 9) because the system currently reaches most of the proposed facilities. The pumping plants and intakes would receive 12 kV service from the local distribution system, while service to other facilities, including operable barriers, siphons and control gates, intakes and boat locks would be at 480 volts. Operable barriers under this alignment would also have backup generation to ensure continued operational control during outages. Wood poles for the 12 kV service would be spaced 300 feet apart, on average, have a height of 40 to 45 feet, and would result in a disturbed area of 2 feet in diameter. Facilities receiving 480 volt service require a three phase service drop (three or four wires) from a utility pole with a 12kV/480 volt 3 phase transformer mounted on it. Alternatively, the utility may choose to site the transformer on a pad (ground level) at the point of service and bring 12 kV utility service to the transformer. For a pad-mounted transformer, there would be a disturbed area of 8 feet by 8 feet.

Towers for 230 kV transmission lines employed in other conveyance alignments would be spaced, on average, 750 feet away from each other. Their physical footprint would be approximately 30 square feet, with foundations at each leg measuring 3.5 to 5 feet in diameter. If a horizontal conductor configuration is chosen, the average tower height will be 95–100 feet, while towers configured for vertical conductors would be 130 feet high. Based on the potential utility providers' design practices, the 230 kV towers would most likely be monopoles (both utilities), with H-frame and lattice towers being options for a WAPA interconnection. The configuration may need to be a dual circuit design to accommodate future expansion for the utility. To discourage raptor perching, a dipped cross-arm configuration could be used in place of davit arms on monopole structures.

The 69 kV transmission lines would almost certainly be monopoles, either steel or wood depending on the utility. To meet the raptor-safe design guidelines, the 69 kV wood pole structure should be 60 inches minimum between the conductor (end of insulator) to pole face in areas of raptor concern. Poles for the 69 kV lines would be spaced 450 feet apart, on average. Wood poles would result in a disturbed area with a diameter of 2 feet while steel poles typically entail foundations 5-6 feet in diameter. Poles would typically be about 60 feet above ground (70-foot poles, embedded 10 feet). A shield wire (at the top of the structure) may be required by either utility for both 230 kV and 69 kV transmission.

For the electrical transmission facilities provided from the utility interconnection to and between the BDCP facilities, industry standard techniques will be incorporated into power line designs to minimize impacts to birds. For monopole and lattice structures, the material coating would be selected for color and reflectivity consistent with meeting visibility goals to mitigate bird strikes and collisions.

Construction

New transmission lines will generally follow the conveyance alignments, and be constructed within the project right of way. Construction of 230 kV and 69 kV transmission lines would require a corridor width of 100 feet and, at each tower or pole, 100 feet on one side and 50 feet on the other side for construction laydown, trailers and trucks. Construction would also require about 350 feet along the corridor (measured from the base of the tower or pole) at conductor pulling locations, which include any turns greater than 15 degrees and/or every 2 miles of line.

For construction of 12 kV lines (when not sharing a 69 kV line), a corridor width of 25 to 40 feet is necessary, with 25 feet in each direction along the corridor at each pole. Construction would also require 200 feet along the corridor (measured from the base of the pole) and a 50-foot-wide area at conductor pulling locations, which include any turns greater than 15 degrees and/or every 2 miles of line. For a pole-mounted 12 kV/480 volt transformer, the work area is only that normally used by a utility to service the pole (typically about 20 by 30 feet adjacent to pole). For pad-mounted transformers, work area is approximately 20 fet by 30 feet adjacent to the pad (for construction vehicle access).

3.6.1.7 Separate Corridors Conveyance Levee Construction and Modification

Description

The separate corridors conveyance (Alternative 9) would rely on existing levees to contain and convey water to existing diversion facilities in the south Delta.

This alignment would entail construction of a 4,000-foot segment of new levees at Old River, isolating Old River from the Tracy Fish Collection Facility and connecting Clifton Court Forebay to the Fish Facility. Setback levees on the south side of Victoria Canal would also be constructed to accommodate the dredged and expanded canal under this conveyance alternative. New levees would be constructed around pumping plants and operation equipment for the operable barriers. New levees or levee modifications constructed for the separate corridors conveyance would be designed to meet similar flood protection levels as the existing levee.

A typical new levee would share the shape, slope, and dimensions of those described above for intake facilities. A notable difference is that the height of the levees would be between approximately 10 and 15 feet, matching the height of existing levees in the Delta. This corresponds to a base width of approximately 80 to 260 feet.

Refer to Table 3-8 for a description of the physical characteristics of the Separate Corridors conveyance.

Operation and Maintenance

[Note to reviewers: this is a data/information gap]

Construction

To construct levees, compacted lean clayey and/or silty soils would be imported to the site. Excavation and foundation improvement activities would be similar to those described above, with the use of riprap for waterside armoring. Access roads would be maintained along the landside levee toe or along the levee crest, while a dedicated ROW would preclude encroachment from features that could compromise levee integrity. Where levees cross existing agricultural channels, new channels would need to be constructed.

3.6.1.8 Temporary Access and Work Areas for Intake, Canal, and Pipeline/Tunnel Construction

Temporary Barge Unloading Facilities

Temporary barge unloading facilities would be constructed at locations along the alternatives for the delivery of construction materials. These facilities would be sized to accommodate various deliveries (tunnel segments, batched concrete, major equipment, etc). Access roads from these facilities to the construction work area would be necessary. The barge unloading facilities would be removed following construction. Depending on the alternative selected, barge unloading facilities could be constructed at one or more of the following locations:

- SR 160 west of Walnut Grove
- Venice Island
- Bacon Island
- Woodward Island
- Victoria Island
- Hog Island
- SR 160 west of Isleton
- Tyler Island

The barge unloading facilities would be used for the delivery and removal of construction materials and equipment. A pier would be built within the worksite footprint of the intake or tunnel for these activities. The barge unloading facility at each location is assumed to be used for the duration of the construction of the intake or tunnel (for approximately 5–6 years). Piers would be disassembled and removed from the site at the end of construction. Installation of the piers would require pile driving.

Road Haul Routes

It is assumed that the majority of haul routes would include interstates, state routes, and local arterial roadways, depending on the location of the work area and the origin-destination of the trip. Key roadways to be utilized as haul routes are assumed to be the federal and state facilities and their intersecting roadways listed below.

- I-5
- I-80
- I-580
- I-205
- SR 160
- SR 12
- SR 4

The reader is referred to Chapter 19, "Transportation," for a more detailed discussion of potential haul routes.

General Construction Work Areas

Work areas during construction will include areas for construction equipment and worker parking, equipment and materials laydown and storage, tunnel muck spoils areas, and stockpiles. Materials to be stockpiled may include those listed below.

- Strippings from various excavations for possible reuse in landscaping.
- Tunnel muck that is slated for reuse after treatment for embankment or fill construction.
- Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section).
- Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas.

Such materials can be stockpiled in the construction areas of the project for later use. Some stockpiles may be used for material conditioning and potential reuse. Temporary stockpile areas may also allow for staging deliveries (offloading), for equipment/materials storage, and for temporary field offices for construction.

Site clearing and grubbing, work area limits, and site access to stockpile locations will be developed. Silt fencing and straw bale dikes will be installed, as needed, to address drainage issues. Dust abatement and other environmental concerns relating to stockpiles will need to be addressed. Stockpile areas may require security fences, gates, and/or cameras.

Depending on the selected tunnel muck handling method, tunnel muck areas may be permanent. Similarly, borrows or spoils areas that cannot be returned to previous uses may constitute permanent physical effects.

3.6.1.9 SWP and CVP South Delta Export Facilities

The SWP and CVP south Delta intake and conveyance facilities include the SWP Clifton Court Forebay, Skinner Fish Facility, Banks Pumping Plant, Tracy Fish Facility, Delta Cross Channel, Jones Pumping Plant, south Delta temporary barriers, Barker Slough Pumping Plant and North Bay Aqueduct, Contra Costa Water District (CCWD) Diversion Facilities, and Suisun Marsh Facilities, as described below. Operation and maintenance of these facilities and modifications proposed under the alternatives are detailed in Section 3.6.4. ESA and CESA coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP are addressed through separate compliance processes and not addressed in the BDCP.

Clifton Court Forebay

Clifton Court Forebay is a 31,000-af regulatory reservoir for the SWP about 10 miles northwest of the City of Tracy. Water flows through Grant Line Canal and into Clifton Court Forebay through radial gates near the confluence of Grant Line Canal and West Canal. The gates are operated on the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water elevation fluctuation in the south Delta. The intake gates enable incoming flow into Clifton Court Forebay to be measured and conveyed to the Banks Pumping Plant. Water can be stored in Clifton Court Forebay to be conveyed at a later time to maximize pumping during off-peak hours. The off-peak hours are typically 10:00 p.m. to 7:00 a.m. Monday through Saturday, all day Sunday, and many holidays. The gates prevent reverse flow back into Old River.

The period of the tidal cycle in which the Clifton Court Forebay intake gates are opened is selected to minimize impacts on south Delta water users. DWR reports that the surface water elevation in Clifton Court Forebay varies throughout the day, typically between -2 feet and +0 to +2 feet depending on tidal conditions and predetermined gate opening priority for the forebay. Typical operation is targeted to restore the surface elevation to -1 foot each day at midnight. This water level creates the required hydraulic head differential between the available water in the Delta and Clifton Court Forebay to allow water to flow from the Delta into the forebay to provide sufficient water for SWP's Delta Export Allocation for the following day. The Clifton Court Forebay gates are closed once DWR's daily allocation has been achieved. If tidal or other conditions prevent DWR's daily allocation from being achieved, the schedule for the following day's water conveyance operation is adjusted to minimize impacts on DWR deliveries.

The maximum design operating storage at Clifton Court Forebay is 28,653 af at the water surface elevation of +5 feet. The minimum design operating storage is 13,965 af at the minimum water surface elevation of -2 feet. DWR has indicated that unless engineering improvements are made to the perimeter embankment around Clifton Court Forebay, the maximum operating water surface elevation for future water operations should be limited to +4 feet.

Skinner Fish Facility and Banks Pumping Plant

Water from Clifton Court Forebay is conveyed through Skinner Fish Facility to the California Aqueduct Intake Channel, which extends to the Banks Pumping Plant. Large fish and debris are directed away from the Banks Pumping Plant by a 388-foot-long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers into a secondary system of screens and pipes and then into holding tanks. The salvaged fish are returned to the Delta in oxygenated tank trucks.

The 2009 NMFS BO requires DWR to initiate studies to develop predator controls in Clifton Court Forebay to reduce salmonid and steelhead losses in the forebay by March 31, 2014, such that losses do not exceed 40%, and to remove predators in the secondary channel at least once per week. This BO also requires modifications to operations of the Skinner Fish Facility by December 31, 2012, to achieve at least 75% salvage efficiency for Central Valley salmonids,steelhead, and the southern Distinct Population Segment of North American green sturgeon.

Banks Pumping Plant has an installed pumping capacity of 10,670 cfs. It discharges into five pipelines that convey water into a roughly 1-mile-long canal, which in turn conveys water to Bethany Reservoir.Bethany Reservoir serves as a regulating reservoir for the downstream canals that deliver SWP water.

The maximum daily pumping rate at Banks Pumping Plant is controlled by a combination of the State Water Resources Control Board's (State Water Board's) Water Rights Decision 1641 (D-1641), an adaptive management process described in the 2008 USFWS and the 2009 NMFS BOs, and permits issued by USACE that regulate the rate of diversion of water into Clifton Court Forebay. The diversion rate is normally restricted to 6,680 cfs as a 3-day average inflow and 6,993 cfs as a 1-day average inflow to Clifton Court Forebay. The diversions may be greater in the winter and spring depending on San Joaquin River flows at Vernalis.

The Byron-Bethany Irrigation District diverts waterfrom the California Aqueduct Intake Channel through a canal between Skinner Fish Facility and Banks Pumping Plant. This diversion occurs under an agreement related to historical water rights to the waters near Clifton Court Forebay.

Tracy Fish Facility and Jones Pumping Plant

Tracy Fish Facility, located at the Delta-Mendota Canal intake, and Jones Pumping Plant operate continuously because the CVP facilities do not include a regulating reservoir like Clifton Court Forebay. Water is diverted from Old River, upstream of itsconfluence with Grant Line Canal, through the Tracy Fish Facility intothe 2.5-mile unlined upper reach of the Delta-Mendota Canal that conveys water to the Jones Pumping Plant. The facility uses louver screens to divert fish into tanker trucks. The salvaged fish are returned to the Sacramento River near Horseshoe Bend and the San Joaquin River upstream of the Antioch Bridge.

The CVP facilities do not include storage capacity in the south Delta. Consequently, the facilities usually operate continuously when diversions are allowed. Water supply operations of Jones Pumping Plant are constrained by tidal fluctuations and the capacity of the Delta-Mendota Canal between Jones Pumping Plant and the San Luis Reservoir complex. This capacity, including pumping capacity at O'Neill Pumping Plant, is about 4,200 cfs. Accordingly, operations of Jones Pumping Plant are limited to 4,200 cfs unless deliveries are required for CVP water service contractors that divert upstream of O'Neill Pumping Plant. In many months, operations criteria limit Jones Pumping Plant to diversions of less than 4,200 cfs; however, in summer, fall, and winter months, there are opportunities to divert up to 4,600 cfs.

Delta-Mendota Canal/California Aqueduct Intertie

The Delta-Mendota Canal/California Aqueduct Intertie (Intertie) is currently under construction. The Intertie was designed to include a pipeline between the Delta-Mendota Canal and the California Aqueduct south of the Banks and Jones Pumping Plants, and a new pumping plant on the Delta-Mendota Canal that would allow up to 467 cfs to be pumped from the Delta-Mendota Canal to the California Aqueduct. Currently, the O'Neill Pumping Plant, farther south along the Delta-Mendota Canal, creates a bottleneck due to a design capacity of 4,200 cfs, causing Jones Pumping Plant to pump below capacity in fall and winter. Diverting an additional 400 cfs to the California Aqueduct would allow the Jones Pumping Plant to pump at a maximum monthly average of about 4,600 cfs throughout the year. It is anticipated that this operational modification would be implemented primarily September through March. Conversely, up to 900 cfs could be conveyed from the California Aqueduct to the Delta-Mendota Canal along the same pipeline by gravity. Operations of the Intertie would be subject to all applicable export pumping restrictions for water quality and fisheries protection.

South Delta Temporary Barriers Project

The existing South Delta Temporary Barriers Project consists of annual installation and removal of four temporary rock barriers across south Delta channels to protect San Joaquin River fall-run Chinook salmon from the SWP and CVP south Delta export facilities and to benefit southern Delta agricultural diverters by increasing water elevations, improving circulation, and improving water quality. The barriers are installed at the following locations.

- Tidal control facilities with rock barriers and gated culverts to improve water elevations and water quality for agricultural diversions during the growing season are in place at the following locations.
  - Middle River near Victoria Canal, about 0.5 mile south of the confluence of Middle River, Trapper Slough, and North Canal.
  - Old River along the Fabian Tract, about 0.5 mile east of the Delta-Mendota Canal intake.
  - Grant Line Canal, about 400 feet east of the Tracy Boulevard Bridge.
- A rock barrier or nonphysical barrier is installed in the fall at the Head of Old River near the confluence with the San Joaquin River to improve dissolved oxygen in the San Joaquin River by reducing flows into Old River during salmon migration in the San Joaquin River.
- A rock barrier or nonphysical barrier is installed in the spring to reduce exposure of downstream migrating salmon to diversions at the SWP and CVP south Delta export facilities.

Joint Point of Diversion

Under State Water Board D-1641 (December 1999, revised March 2002), Reclamation and DWR are authorized to use/exchange diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The sharing of the SWP and CVP export facilities is referred to as Joint Point of Diversion (JPOD). In general, JPOD capabilities are used to accomplish the following four objectives.

- When wintertime excess pumping capacity is available during Delta excess conditions, and total SWP and CVP San Luis Reservoir storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis Reservoir storage may elect to use JPOD capabilities.

- When summertime pumping capacity is available at Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP releases for south of Delta water supplies.
- When summertime pumping capacity is available at Banks Pumping Plant or Jones Pumping Plant to facilitate water transfers, the JPOD may be used to further facilitate the water transfer.
- During certain coordinated SWP and CVP operation scenarios for fish entrainment management, the JPOD may be used to shift SWP and CVP exports to the facility with the least fish entrainment impact and minimize exports at the facility with the most fish entrainment impact.

Barker Slough Pumping Plant and North Bay Aqueduct

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct for delivery in Napa and Solano Counties. The North Bay Aqueduct intake is approximately 10 miles from the mainstem Sacramento River at the end of Barker Slough in the Cache Slough area. The maximum pumping capacity is 175 cfs (pipeline capacity). During the last few years, daily pumping rates have ranged between 0 and 140 cfs.

Currently, DWR and Solano County Water Agency are evaluating analternative intake for the pumping plant because operations have been limited by water quality constraints and provisions in the 2008 USFWS and 2009 NMFS BOs. Water conveyance operations of this potential new facility are incorporated in this analysis.

Contra Costa Water District Diversion Facilities

CCWD intake facilities divert water for irrigation and municipal and industrial uses under CVP contract from the Delta at Rock Slough; under its own State Water Board permit and license at Mallard Slough; and under its own Los Vaqueros water right permit at Old River near SR4.

Besides these intake facilities, CCWD's system includes the Contra Costa Canal conveyance facility and shortcut pipeline, conveyance facilities constructed concurrently with the Los Vaqueros Reservoir, and storage facilities at Contra Loma Reservoir and Los Vaqueros Reservoir. The Rock Slough intake facilities, Contra Costa Canal, and shortcut pipeline are owned by Reclamation and operated and maintained by CCWD under contract with Reclamation. Mallard Slough intake, Old River intake, and Los Vaqueros Reservoir are owned and operated by CCWD and covered under separate ESA consultation. CCWD has received take authorization for Los Vaqueros Reservoir operations (including Rock Slough, Mallard Slough, Old River, and the Alternative Intake Project) under ESA Section 7 BOs issued to Reclamation for that purpose. CCWD operations are also included among Reclamation's operations that are covered under the 2008 USFWS and the 2009 NMFS BOs. CCWD has California Endangered Species Act (CESA) take authorization for all its operations under a Section 2081 permit issued by DFG. The Mallard Slough and Old River intakes have fish screens.

CCWD has completed construction of the Alternative Intake Project and associated conveyance facility on Victoria Canal, including the installation of intake fish screens. CCWD is currently constructing fish screens for the Rock Slough intake facility. Both projects are covered under separate ESA consultations.

Water Transfers

State and federal laws governing water use in California promote the use of water transfers to manage water resources, particularly water shortages, provided that certain conditions of the transfer are met to protect source areas and users. Transfers requiring export from the Delta are conducted at times when pumping and conveyance capacity at the SWP or CVP export facilities are available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with SWP and CVP operational guidelines, such that the capabilities of the projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way.

SWP and CVP contractors have independently acquired water and arranged for its pumping and conveyance through SWP facilities. State Water Code provisions grant other parties access to unused conveyance capacity, although SWP contractors have priority access to capacity not being used by DWR to meet SWP contract amounts.

Suisun Marsh Facilities

The existing Suisun Marsh facilities comprise the Suisun Marsh Salinity Control Gates, Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, and various salinity monitoring and compliance stations throughout the Marsh. Since the early 1970s, the California Legislature, State Water Board, Reclamation, DFG, Suisun Resource Conservation District (SRCD), DWR, and other agencies have engaged in efforts to preserve beneficial uses of Suisun Marsh to mitigate the potential impacts on salinity regimes associated with reduced freshwater flows to the marsh. Initially, salinity standards for Suisun Marsh were set by State Water Board D-1485 to protect production of alkali bulrush, a primary waterfowl plant food. Subsequent standards set under State Water Board D-1641 reflect the intention of the State Water Board to protect multiple beneficial uses. A contractual agreement between DWR, Reclamation, DFG, and SRCD includes provision for measures to mitigate the effects of SWP and CVP operations and other upstream diversions on Suisun Marsh channel water salinity. The Suisun Marsh Preservation Agreement requires DWR and Reclamation to meet specified salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements. Maintenance activities for existing facilities include levee repairs, vegetation removal, fish screen cleaning and installation of new screens, mechanical repairs, structural repairs, removal or replacement of monitoring and compliance stations (including in-water work), and instrumentation installation on or near existing facilities.

3.6.2 Conservation Components

This section describes the proposed habitat conservation components of the action alternatives by conservation measure. The descriptions present the general locations of restoration opportunities and potential physical modifications necessary to implement habitat conservation–related activities in enough detail to support program-level impact analyses related to habitat and land use conversions. Any differences in conservation components (e.g., restored habitat acreages) between the action alternatives are noted in the descriptions in the subsections below.

Specific locations for the conservation actions have not been identified at this time. Therefore, the analysis considers typical construction and operations and maintenance activities that would be undertaken for implementation of the habitat restoration and enhancement efforts. Project-level implementation of the conservation actions would be subject to additional environmental review.

Habitat restoration and enhancement conservation measures are anticipated to include, but would not be limited to, the types of actions listed below.

- Grading, excavation, and placement of fill material.
- Breaching, modification, or removal of existing levees and construction of new levees.
- Modification, demolition, and removal of existing infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure).
- Construction of new infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure).
- Removal of existing vegetation and planting/seeding of vegetation.
- Controlling the establishment of nonnative vegetation to encourage the establishment of target native plant species.
- Control of nonnative predator and competitor species (e.g., feral cats, rats, nonnative foxes).

Habitat management actions include all activities undertaken to maintain the intended functions of protected, restored, and enhanced habitats over the term of the BDCP. Habitat management actions are anticipated to include, but are not limited to, the activities listed below.

- Minor grading, excavation, and filling to maintain infrastructure and habitat functions (e.g., levee maintenance; grading or placement of fill to eliminate fish stranding locations).
- Maintenance of infrastructure (e.g., buildings, roads, fences, electric transmission and gas lines, irrigation infrastructure, fences).
- Maintaining vegetation and vegetation structure (e.g., grazing, mowing, burning, trimming).
- Ongoing control of terrestrial and aquatic nonnative plant and wildlife species.

As part of the proposed BDCP, avoidance and minimization measures and best management practices (BMPs) would be implemented to avoid and minimize potential adverse effects of habitat restoration, enhancement, and management activities. These measures are described in Appendix __, *Environmental Commitments*.

3.6.2.1 Yolo Bypass Fishery Enhancement (CM2)

Under this conservation measure projects would be implemented in the Yolo Bypass to improve upstream and downstream fish passage, reduce straying and stranding of native fish, increase the availability of floodplain rearing and spawning habitat for covered fish species, and stimulate the food web by boosting aquatic productivity. The projects under this conservation measure willbe part of the *Yolo Bypass Fisheries EnhancementPlan* (YBFEP). The YBFEP will, with stakeholder and scientific input, further refine CM2 into one or more component projects for which project-specific environmental-compliance documentation will be completed.

This conservation measure would be implemented under all action alternatives. CM2 actions are proposed for implementation in four phases: Near Term (Phase 1—first five years of BDCP implementation, and; Phase 2—second five years of BDCP implementation), Phase 3—Early Long-Term and Phase 4—Late Long-Term. These projects are described below.

Phases 1 and 2, Near Term (First 10 years of BDCP Implementation)

Projects to be Implemented

- Accelerate fish rescue and improved fish stranding documentation (Phase 1).
- Additional hydrologic monitoring stations and studies (Phase 1)
- Floodplain fish rearing pilot project at Knaggs Ranch, not to exceed 100 acres (Phase 1)
- Construct and study up to four experimental ramps at the Fremont Weir to test whether they can provide effective passage of adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir to the Sacramento River when the river overtops the weir by approximately 3 feet) (Figure 3-54). Specific design criteria for the ramp have not yet been determined. Monitoring technologies will be used to collect information on fish passage to evaluate its efficacy at passing adult fishes (Phase 1).
- Construct up to three sets of up to three fish ladders, with at least one set to serve the western length of Fremont Weir. Because the Fremont Weir is nearly two miles long, and is contructed in two distinct lengths, these auxiliary fish ladders will be provided to help fish pass the weir regardless of the location they approach it from. ,At least one set will be placed adjacent to the main gated seasonal floodplain inundation channel (see below) to provide passage at times when velocities or part-open gate configurations would otherwise be impassable or provide poor fish passage. It is likely that at least one of the fish ladders will replace, and possibly increase the width of, the existing Fremont Weir fish ladder (Phase 1).
- If YBFEP determines screening small Yolo Bypass diversions to be an appropriate means to hold existing irrigation practices harmless, construct fish screens on small Yolo Bypass diversions. (Phase 1)
- Construct new or replacement operable check-structures at Tule Canal/Toe Drain to facilitiate continued agriculture in the Yolo Bypass while promoting fish passage in season (Phase 1).
- Replace the Lisbon Weir with a fish-passable gate structure that maintains or improves the ability of impounded water for irrigation (Phase 1).
- Lower Putah Creek will be realigned to improve upstream and downstream passage of Chinook salmon and steelhead. The action will also include floodplain habitat restoration to provide benefits for multiple species on existing public lands. This action will be designed so that it will not create stranding or migration barriers for juvenile salmon (Phase 1).
- Support fish passage, water quality and spawning habitat improvements in Putah Creek upstream of the Yolo Bypass Wildlife Area and downstream of Solano Diversion Dam (Phase 1).
- Improve water supply for the Yolo Bypass Wildlife Area. Other Conservation Measure actions to improve Lisbon Weir and provide adult fish passage at Fremont Weir over a broader season will improve Yolo Bypass Wildlife Area water supply at Lisbon Weir. Other actions will also be considered that have not yet been fully defined or developed. (Phase 1).
- Evaluate the desirability of using supplemental flows through Knights Landing Ridge Cut, introducted via redesign of Colusa Basin Drain Outfall Gates, increased operation of upstream unscreened pumps or other means. If currently unscreened pumps were to be utilized for more than a pilot period, the pumps would need to be screened or replaced with fish-friendly pumps (Phase 1 and 2)

- Experiment with differing approaches to operating the existing fish ladder at Fremont Weir (removing wooden baffles and monitoring fish passage) (Phase 1) and widen existing fish ladder (Phase 2).

- Modify a section of the Fremont Weir to be able to introduce managed flows to the Yolo Bypass at times when Fremont Weir is not overtopping. The Fremont Weir would continue to passively overtop when the Sacramento River stage exceeds the height of the weir. In the BDCP Effects Analysis, it is assumed a section of the Fremont Weir will be lowered to 17.5 feet (NAVD88). Lower elevations may be considered if necessary to satisfy inundation targets or fish passage needs. The weir section would be replaced with operable gates that will allow for controlled flow into the Yolo Bypass when the Sacramento River stage at the weir exceeds 17.5 feet. The gates will be designed and operated to provide for the efficient upstream and downstream passage of sturgeon and salmonids to and from the Yolo Bypass into the Sacramento River to the extent possible when seasonal floodplain flows are introduced, since the seasonal floodplain inundation flows will attract fish migrating upstream (Phase 2).

- If deemed necessary to enhance capture of juveniles into Yolo Bypass through the gated seasonal floodplain inundation channel (described above), construct and operate Nonphysical or physical barriers in the Sacramento River to enhance capture of juveniles into Yolo Bypass through the gated seasonal floodplain inundation channel (Phase 2—or ELT since conditional)

- Construct associated support facilities (operations buildings, parking lots, access facilities such as roads and bridges) necessary to provide safe access for maintenance and monitoring (Phase 2).

- Fish ladder placement at Freemont is intended to result in positive drainage from the stilling basin, with very little, if any, additional work to the stilling basin. Examples of potential stilling basin modification at Fremont Weir could include concrete work over short sections of the weir to smooth the transition between the Freemont Weir and land immediately downstream of it, or adding an additional veneer or concrete to portions of the settling basin (Phase 2).

- Improve levees adjacent to the Fremont Weir Wildlife Area if required, or if spoils can be beneficially used to bolster levees near to excavation areas (Phase 2).

- Replace agricultural crossings of the Tule Canal/Toe Drain with fish-passable structures such as flat car bridges, earthen crossings with large, open culverts. (Phase 2)

- Construct and test flood-neutral fish barriers to prevent fish from straying into Knights Landing Ridge Cut and the Colusa Basin Drain. These barriers will be most effective when employed in association with attraction flows to a location such as at Fremont Weir that is fish-passable and leads to the mainstem Sacramento River. (Phase 2)

- Through modeling and further concept development, determine what types of grading, removal of existing berms, levees, and water control structures, construction of berms or levees, re-working of agricultural delivery channels, and earthwork or construction of structures to reduce Tule Canal/Toe Drain channel capacities are necessary to improve the distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass. The action will include modifications that will allow water to inundate in certain areas of the bypass to maximize biological benefits and reduce stranding of covered fish species in isolated ponds, minimize impacts to terrestrial covered species, including giant garter snake, and accommodate other existing land uses (e.g., wildlife, public, and agricultural use areas). Necessary lands will be acquired in fee-title or through conservation or flood easement (Phase 2).

Phase 3, Early Long Term (approximately 2022 to 2026)

- At a minimum, modifications will be made to reduce leakage at the Sacramento Weir and thereby reduce attraction of fish from the Yolo Bypass to the weir where they cannot access the Sacramento River and could become stranded. The Yolo Bypass Fisheries Enhancement Plan will review the benefits and necessity of constructing fish passage facilities at the Sacramento Weir to improve upstream adult fish passage and positive drainage to reduce juvenile fish stranding. This action may require excavation of a channel to convey water from the Sacramento River to the Sacramento Weir and from the Sacramento Weir to the Toe Drain, construction of new gates at all or a portion of the weir, and modifications to the stilling basin.

Site Preparation, Earthwork, and Other Site Activiti es

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.2.2 Natural Communities Protection (CM3)

This conservation measure provides the mechanism and guidance for the acquisition of lands and the establishment of a system of conservation lands in the Plan Area necessary to meet BDCP natural community and species habitat protection objectives. This system of conservation lands will be built over the implementation term of the BDCP to protect and enhance areas of existing natural communities and covered species habitat, protect and maintain occurrences of selected plant species with very limited distributions, provide sites suitable for restoration of natural communities and covered species habitat, and provide habitat connectivity among the various BDCP conservation land units in the system.

The BDCP's commitments of habitat conservation acreage targets for the various natural communities are listed below. These targets represent the minimum extent of land that would be acquired; the actual extent acquired would likely be greater because acquired parcels may not consist wholly of habitat types that contribute to achieving conservation targets. Restoration under Alternative 5 would result in 40,000 fewer acres of restored tidal habitat than the other action alternatives. Total tidal habitat restoration under Alternative 5 would be 25,000 acres. Additionally, there could potentially be differences in tidal, valley/foothill riparian, grassland, vernal pool complex, and nontidal freshwater perennial emergent wetland and nontidal perennial aquatic habitat restored under Alternative 8, as described for CMs 4–10 in the following sections.

- 65,000 acres of tidal habitat restored (CM4).
- 5,000 acres of valley/foothill riparian habitat restored (CM7).
- 2,000 acres of grassland habitat restored (CM8), and 8,000 acres of grassland habitat protected.
- Vernal pool complex restored to achieve no net loss (CM9), and 600 acres vernal pool complex protected.
- 400 acres of nontidal freshwater perennial emergent wetland and nontidal perennial aquatic habitat restored (CM10).
- 400 acres of alkali seasonal wetland complex protected.

- 16,620–32,640 acres of agricultural habitats protected.

Lands may be acquired through the following mechanisms.

- Purchase in fee title.
- Permanent conservation easements.
- Limited term conservation easements.
- Change to more protective land use designation on federally or state-owned lands.
- Permanent agreements with state, federal, and local flood control agencies that enable the restoration, enhancement, and management of floodplain and channel margin habitats along levees and lands under flood easements.
- Purchase of mitigation credits from private mitigation banks.

The implementation schedule for actions to preserve natural communities assumes that acquisition, protection/preservation, enhancement, and management of existing vernal pool complex, alkali seasonal wetland complex, grassland habitat, and agricultural habitats will be initiated prior to BDCP authorization. Implementation would occur approximately concurrent with or in advance of the adverse effects of BDCP implementation on these natural communities and the covered species habitats they support. The schedule assumes that, except for protection actions implemented in the second year following BDCP authorization, a 2-year period will be necessary to identify and bring under protection (e.g., through conservation easement, fee title acquisition, other means) existing natural communities.

3.6.2.3 Tidal Habitat Restoration (CM4)

As indicated above, BDCP implementation would provide for the restoration of 65,000 acres of freshwater and brackish tidal habitat within the BDCP ROAs under all the action alternatives except Alternative 5 and potentially Alternative 8. Under Alternative 5, 25,000 acres of tidal marsh habitat would be restored. Implementation of Alternative 8 would result in the restoration of 65,000 acres or a number to be determined. The extent of restored tidal habitat includes a contiguous habitat gradient encompassing restored shallow subtidal aquatic habitat, restored tidal mudflat, restored tidal marsh plain habitat, and adjoining transitional upland habitat (Figure 3-1). The restored tidal habitat would also include areas that would function as tidal marsh plain if sea level were to rise by 3 feet. Although specific locations have not been confirmed, the conceptual locations listed below have been identified for all the action alternatives except Alternative 9.

- At least 5,000 acres of freshwater tidal habitat in the Cache Slough ROA in Conservation Zones 1 and 2. Areas suitable for restoration include, but are not limited to, Haas Slough, Hastings Cut, Lindsey Slough, Barker Slough, Calhoun Cut, Liberty Island, Little Holland, Yolo Ranch, Shag Slough, Little Egbert Tract, and Prospect Island. The Cache Slough ROA includes approximately 21,000 acres with suitable elevations for tidal habitat.
- At least 1,500 acres of freshwater tidal habitat in the Cosumnes/Mokelumne ROA in Conservation Zone 4. Areas suitable for restoration include McCormack-Williamson Tract, New Hope Tract, Canal Ranch Tract, Bract Tract, Terminous Tract north of SR 12, lands adjoining Snodgrass Slough, South Stone Lake, and Lost Slough. Depending on site-specific conditions, levees may be constructed to avoid inundation of deeply subsided lands.

- At least 2,100 acres of freshwater tidal habitat in the West Delta ROA in Conservation Zones 5 and 6. Multiple small areas suitable for restoration include Dutch Slough; Decker Island; portions of Sherman, Jersey, Bradford, Twitchell, Brannon, and Grand Islands; and portions of the north bank of the Sacramento River.
- At least 5,000 acres of freshwater tidal habitat in the South Delta ROA in Conservation Zone 7. Multiple areas suitable for restoration include Fabian Tract, Union Island, Middle Roberts Island, and Lower Roberts Island. The selected locations would need to avoid conflicts with existing and future south Delta conveyance facilities.
- At least 7,000 acres of brackish water tidal habitat within Suisun Marsh ROA in coordination with the Suisun Marsh Habitat Restoration and Management Plan.
- Approximately 44,400 acres of the target total will be distributed among the ROAs at the discretion of the BDCP Implementation Office based on land availability, biological value, and practicability considerations.

The implementation schedule for tidal habitat restoration actions would be based on the assumption that site acquisition, planning, and any required environmental or regulatory compliance activities for the first 4,000 acres of tidal habitat restoration are initiated prior to Plan authorization. The first 500 acres of these initial restoration actions, therefore, could be constructed immediately following Plan authorization. Restoration of the remaining 3,500 acres would occur in years 3 through 5. These initial restoration actions are expected to require less time to acquire and permit than restoration actions for other natural communities because tidal habitat restoration is assumed to be implemented on sites that will be readily available to the Implementation Office (e.g., state- and federally owned lands). The schedules for implementation of subsequent tidal habitat restoration actions are based on the assumption that 5 years are required to acquire restoration lands, conduct analyses, develop conceptual plans, obtain any outstanding environmental and regulatory approvals and permits, develop bid specifications and drawings, construct new levees (if required) and habitat features, and breach existing levees. It is anticipated that most or all of tidal habitat restored during the near-term implementation period will be restored in the Cache Slough Complex, Suisun Marsh, and West Delta areas.

Design of the tidal habitat restoration areas would consider the following issues.

- Spatial distribution of restored tidal marsh habitats within the Delta.
- Extent, location, and configuration of restored tidal habitat areas.
- Predicted tidal range at tidal habitat restoration sites following reintroduction of tidal exchange.
- Distribution of restored tidal habitats along salinity gradients to optimize the range of habitat conditions for covered species and food production.
- Size and location of levee/dike breaches to maintain flow velocities that would minimize establishment of nonnative submerged and floating aquatic vegetation and habitat for nonnative predatory fish.
- Cross-sectional profile of tidal habitat restoration sites (elevation of marsh plain, topographic diversity, depth, and slope).
- Density and size of restored tidal habitat channels appropriate to each restoration site.
- Use of dendritic (i.e., branching, like tree roots) network of tidal channels.

- Potential hydrodynamic and water quality effects on other areas of the Delta.

Areas to be restored would be modified by breaching and lowering of levees, new or modified levees to protect adjacent areas from flooding, connection of remnant sloughs or channels to improve circulation, and modified ground elevations to reduce impacts of subsidence. The final design would consider methods to improve conditions for target species, such as considerations for providing food web support, reducing predator potential, and maintaining healthy habitat conditions.

Site Preparation, Earthwork, and Other Site Activities

Construction site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the restoration habitat areas could include the construction activities described below on the landside and waterside of existing levees in areas that would be selected for tidal habitat restoration.

Modification of Landforms

Existing land elevations could be modified through grading and filling or subsidence reversal. These activities could be completed prior to breaching of levees and associated inundation of the site, as well as in the water.

Grading activities performed as part of restoration actions could include excavation and filling of material, shaping disturbed soils to smoothly transition into existing elevations at boundaries of construction areas, and smoothing and contouring of the disturbed ground surfaces to provide shallow elevation gradients from marsh plain to upland transition habitat. The specific landform plans would be developed for each location and evaluated in future environmental documentation.

Soil could be moved from higher elevations in the area to provide fill for placement on subsided lands for establishment of tidal marsh. Fill could also be imported to fill the subsided areas. In some areas, tules could be planted and farmed for several years to raise the elevation of subsided lands.

In adjacent areas that would not be inundated, grading could occur to ensure positive drainage and provide more diverse geomorphic surfaces for habitat.

As described in Appendix __-, *Environmental Commitments*, erosion and dust control measures would be implemented during construction, and a Stormwater Pollution Prevention Plan (SWPPP) would be developed for each site.

Breaching and Modification of Levees

Levee modifications, including levee breaching or lowering, could be performed to reintroduce tidal exchange, reconnect remnant sloughs, restore natural remnant meandering tidal channels, encourage development of dendritic channel networks, and improve floodwater conveyance. Levee modifications could involve the removal of vegetation and excavation of levee materials. Excess earthen materials could be temporarily stockpiled, then respread on the surface of the new levee slopes where applicable or disposed of offsite.

During detailed analyses of each location, levee breach sizes necessary to provide full tidal exchange between sloughs, open water, and restored tidal marsh areas would be identified. Breach lengths would be developed for each site depending on channel hydraulic geometry. In larger inundated areas (e.g., than 200 acres), the breaches could be more than 100 feet long and extend below the water elevations during high or low tides. The edges of the breaches would be protected from erosion and related failure of the adjacent levee. Erosion protection could include geotextile fabrics, rock revetments, riprap, or other material selected during future evaluations for each location. Aggregate rock could be placed on the remaining levees to provide an access road to the breach location.

Levee lowering could involve removal of material in the upper sections of an existing levee, re-contouring of the levee slopes to provide stability for the shorter levee, placement of erosion protection on the slopes and specifically on the top of the levee that was previously subject to tidal action. Lowering levees provides opportunities for seasonal or periodic inundation of lands during high flows or high tides. This technique could be used to improve habitat or to reduce velocities and elevations of floodwaters. To reduce erosion potential on the new levee crest, a paved or gravel access road could be constructed with short (approximately 1 foot) retaining walls on each edge of the crest to reduce undercutting of the roadway by high tides. Levee modifications could also include excavation of watersides of the slopes to allow placement of slope protection, such as riprap or geotextile fabric, and to modify slopes to provide levee stability. Erosion and scour protection could be placed on the landside of the levee and continued for several feet onto the land area away from the levee toe.

Exit channels would be excavated on lands to be inundated to allow fish to leave the inundated area as waters recede.

Neighboring levees could require modification to accommodate increased flows or to reduce effects of changes in water elevation or velocities along channels following inundation of tidal marshes. Hydraulic modeling would be used during subsequent analyses to determine the need for such measures.

New Levees

New levees would be constructed to separate lands to be inundated for tidal marsh from non-inundated lands, including lands with substantial subsidence. Levees could be constructed as described for the new levees at intake locations.

Dredging

Restoration actions may include channel dredging, drying dredged spoils before hauling or placement, placement of dredged material on lands or levees, and offsite disposal in spoils areas. Depending on the locations and restrictions related to habitat and channel configuration, dredging operations may be staged from a barge floating in the channel or from the top of the levee. Dredging could be required periodically to maintain tidal circulation.

Dredging methods can generally be classified in two categories: hydraulic dredging and mechanical dredging.

Hydraulic Dredging

Hydraulic dredging utilizes barge-mounted pumps equipped with hydraulic cutter jets to mobilize sediments and a siphon with a pump to move the water and dredge spoils, referred to as slurry, to settling ponds for dewatering. The size of the dewatering areas depends on slurry flow rate, amount of total dredge spoils, and settling rate of the material. This type of dredging minimizes sediment in waterways; however, it requires management of large volumes of water. Hydraulic dredging is used in situations where there are large areas to be dredged, the concern for induced turbidity and harm to benthic vegetation is great, and there is ample area available for drying basins, as this method entrains more water in the sediment and requires greater drying capacity. Bargesand tugboats could be used to transport dredged materials.

Mechanical Dredging

Mechanical dredging utilizes barge-mounted clamshell-type buckets or land-based drag line buckets to excavate the dredge spoils. Typically, the spoils are placed in holding areas on the barge for dewatering and transferred to a land disposal area for disposal. This dredging method results in more sediment in the waterway than does hydraulic dredging. However, the amount of water to be removed from the sediment prior to transport and disposal is less.

The clamshell dredging method excavates a water-sediment mix from the channel bottom with a clamshell bucket and deposits it to a drying basin or onto a barge to be transported to a drying basin. The operation may be staged from a barge floating in the channel or from the top of the levee, depending on restrictions in habitat and channel width. The clamshell dredging method can cause greater disruption to channel vegetation than hydraulic dredging when the bucket scrapes layers of sediments from the channel bottom. This method would likely be used in situations where there is limited space for drying basins, the likelihood of major disruption to vegetation and other organisms in the channel bottom is minimal, the area to be dredged is small, there are channel islands, or there is limited concern regarding temporary turbidity and sedimentation in the water.

The dragline dredging method excavates a water-sediment mix from the channel bottom with a bucket and deposits it either into a drying basin or onto a barge to be transported to a drying basin. The use of the dragline method requires sufficient height and swing clearance for the crane. The dragline method is effective in shaping the channel bottom with relative control.

Drying Operations

Dredged material may be placed into drying basins to be dried for beneficial reuse. Drying basins may be constructed on the landside of the levees, typically adjacent to the channel or suitable interior low areas. The basins would be constructed of onsite soil and compacted to reduce embankment erosion.

Three basins—primary, secondary, and return—are generally used for slurry from hydraulic dredging due to the amount of water in the slurry. The primary and secondary basins settle sediments over a period of 4–5 weeks in each basin. Water in the return basin is then returned to the waterway. Each unlined basin could be up to 100 acres in surface area and up to 6 feet deep with 2 feet of freeboard.

For mechanical dredging, a single basin could be used. The sediments settle over a period of 2–6 weeks. Dredged material would be tested to determine the presence of toxic materials prior to reuse. Clean dredge spoils could be hauled and placed on agricultural land or on low areas identified for subsidence reversal.

Construction Detour / Access Roads and Utilities Relocation

Relocation of existing roads and utilities could be required to support construction and postconstruction activities at the restoration project site or services to adjacent lands protected by levees. Roads and utilities on the levees to be breached or lands to be inundated that required modification would be constructed to a condition equal to or better than the preconstruction conditions.

Revegetation

Restored freshwater tidal marsh plains would be vegetated primarily with tules and other native freshwater emergent vegetation to reflect the historical composition and densities of Delta tidal marshes. Restored brackish tidal marsh plains, such as Suisun Marsh, would be dominated by native brackish marsh vegetation (e.g., pickleweed, saltgrass) appropriate to marsh plain elevations, mimicking the composition and densities of historical Suisun Bay brackish tidal marshes.

To facilitate revegetation of disturbed areas, weed eradication could be used followed by a combination of passive and active revegetation approaches. Passive revegetation techniques could include altering the hydrologic regime to promote the establishment of desirable native vegetation. Active revegetation techniques may include direct seeding and planting of seedlings or containerized stock. Prior to revegetation, undesirable vegetation species could be treated or removed from the restoration site. Disking and ripping could be required to allow for water filtration and deeper penetration and faster growth of plant roots. Direct seeding could be done by broadcasting, hydroseeding, or drill seeding. Soil amendments could be applied to the revegetated area.

3.6.2.4 Seasonally Inundated Floodplain Restoration (CM5)

Under all action alternatives except Alternative 7 and potentially Alternative 8, the BDCP would provide for the restoration of 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south Delta. Under Alternative 7, an additional 10,000 acres of seasonally inundated floodplain habitat would be restored. Implementation of Alternative 8 would result in the restoration of 10,000 acres or a number to be determined.

Seasonally inundated floodplain restoration could occur along channels in many locations in the north, east, and/or south Delta. In most areas, setback levees would be constructed to modify the channel configuration. In some areas, farming could be discontinued within setback levees to allow riparian vegetation to establish. In some areas, farming could be continued in a manner that would be compatible with the restoration area biological objectives, such as minimal use of persistent herbicides and pesticides, and flood management objectives. Residual crop biomass could be used to provide cover, hydrodynamic complexity, and organic carbon sources.

The most promising opportunities for large-scale restoration are in the south Delta along the San Joaquin, Old, and Middle River channels; these locations offer benefits to covered fish species, practicability considerations, and compatibility with potential flood management projects.

The implementation schedule for this conservation measure assumesthat at least 1,000 acres of floodplain would be restored by year 15 and that restoration of the remaining 9,000 acres of floodplain restoration would be completed in increments of 3,000 acres by years 25, 30, and 40, respectively. Each floodplain restoration increment would, on average, require 5 years to identify potential floodplain restoration sites; coordinate planning with USACE, DWR, and other flood control agencies and reclamation districts; and conduct feasibility studies prior to implementation. Following approval of floodplain restoration plans, an additional 5 years are assumed to be required to acquire restoration lands, obtain any outstanding regulatory approvals and permits, develop bid specifications and drawings, construct the new levees and floodplain, and breach existing levees.

Design of the seasonally inundated floodplain restoration areas would consider the following issues.

- Timing, duration, interannual frequency, and spatial extent of inundation.
- Connectivity with tidal marsh and channel habitats.
- Accessibility to migrating fish.
- Stranding risk and effects on fish passage.
- Vegetation type and cover.
- Dry season land use compatible farming practices
- Topography.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the seasonally inundated floodplains could include setting back levees, removal of existing levees, removal of riprap to allow for channel meander between the setback levees, grading to restore drainage patterns and increase inundation frequency and duration, and establishment of riparian habitat.

Seasonally inundated floodplain modifications would be required to be implemented to maintain or improve flood management functions and would be coordinated with USACE, DWR, Central Valley Flood Protection Board (CVFPB), and other flood management agencies to assess the desirability and feasibility of channel modifications. To the extent consistent with floodplain land uses and flood management requirements, if applicable, woody riparian vegetation would be allowed to naturally establish, or plant stock would be derived from adjacent riparian vegetation.

During design, the need for grading would be determined to reduce risk of fish stranding as water recedes. Grading could also be required to convey water from the floodplain into tidal marsh restoration areas.

3.6.2.5 Channel Margin Habitat Enhancement (CM6)

Under all action alternatives except Alternative 7 and potentially Alternative 8, 20 linear miles of channel margin habitat would be enhanced; under Alternative 7, 40 linear miles would be enhanced. Implementation of Alternative 8 would result in the restoration of 20 linear miles or a number to be determined. Channel margin habitat enhancement would restore conditions for rearing and outmigration habitat for juvenile salmonids by modifying channel geometry and restoring riparian, marsh, and mudflat habitats along project and non-project levees.

Channel margin habitat would be enhanced only along channels that serve as important rearing and outmigration habitat for juvenile salmonids. Although channel margin enhancements are intended to provide specific benefits for salmonids, enhancement of these habitats is also expected to improve or restore habitat for other species of covered fish, wildlife, and plants that inhabit channel margin habitats. This measure would be implemented along channels protected by federal Project and/or non-Project levees[3] within the Plan Area. Channel margin habitat enhancements associated with Project levees will not be implemented on the levee, but rather on benches to the outboard side of such levees (Figure 3-21 [to come]). Based on results of effectiveness monitoring for this conservation measure, the BDCP Implementation Office may elect to enhance up to an additional 20 miles of channel margin (for a total of 40 miles) through the adaptive management decision making process. Channel margin habitat enhancement is measured along one side of a channel.

Channels that serve as primary rearing and outmigration habitat for juvenile salmonids, and would therefore be the locations for channel margin enhancement, include the Sacramento River between Freeport and Walnut Grove, the San Joaquin River between Vernalis and Mossdale, and Steamboat and Sutter Sloughs that are protected by federal Project levees and salmonid migration channels in the interior Delta, such as the North and South Forks of the Mokelumne River, that are protected by non-Project levees. The following are minimum geographic requirements for the 20 miles of channel margin enhancement under this measure.

- At least 5 miles would be located along the Sacramento River between Freeport and Walnut Grove.
- At least 5 miles would be located along the San Joaquin River between Vernalis and Mossdale.
- The remaining 10 miles would be distributed among the channels described above.

Actions to enhance channel margin habitats, as appropriate to site-specific conditions include but would not be limited to those listed below.

- Modifying the outboard side of levees or setting back levees to create low floodplain benches designed with variable surface elevations to create hydrodynamic complexity and that support emergent vegetation to provide an ecological gradient of habitat conditions, and higher elevation benches that support riparian vegetation.
- Planting riparian and emergent wetland vegetation on created benches.
- Installing large woody material (e.g., tree trunks and stumps) could be anchored into constructed low benches or into existing riprapped levees to provide similar habitat functions.
- Removing riprap from channel margins where levees are setback to restore seasonally inundated floodplain habitat under CM5 Seasonally Inundated Floodplain Restoration.
- Modifying channel geometry in unconfined channel reaches or along channels where levees are setback to restore seasonally inundated floodplain habitat under CM5, Seasonally Inundated Floodplain Restoration, to create backwater salmonid and splittail rearing and splittail spawning habitat.

The implementation schedule for this conservation measure assumes that channel margin enhancements would be completed in increments of 5 miles of channel (achieved at multiple sites for a total of 5 miles of channel margin length) by years 10, 20, 25, and 30 and that channel margin enhancement will be a component of seasonally inundated floodplain and riparian habitat restoration. Each channel margin habitat enhancement increment would, on average, require 5

[3] Federal "Project Levees" refers to the Federal flood control system, built by the Corps and operated/maintained by local maintenance agencies, protecting California's Central Valley, as authorized by State and Federal governments.

years to identify potential channel margin enhancement sites; coordinate planning with USACE, DWR, and other flood control agencies and reclamation districts; and conduct feasibility studies prior to implementation. Following approval of enhancement plans, an additional 5 years are assumed to be required to obtain any outstanding regulatory approvals and permits, develop bid specifications and drawings, and implement channel margin enhancements.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the channel margin habitat areas could include modification of levees or setting back levees to create low benches designed with variable surface elevations that would support emergent vegetation to provide an ecological gradient of habitat conditions, and higher elevation benches that would support riparian vegetation. Riprap would be removed where levees are set back to restore seasonally inundated floodplain habitat. Channel geometry would be modified in unconfined channel reaches or along channels where levees are set back to restore seasonally inundated floodplain habitat and create backwater salmonid and splittail rearing and splittail spawning habitat.

These activities would be completed in a manner similar to that discussed in Section 3.6.2.3, *Tidal Habitat Restoration* (CM4). Channel margin modifications would be required to maintain or improve flood management functions and would be coordinated with USACE, DWR, CVFPB, and other flood management agencies to assess the desirability and feasibility of channel modifications.

Riparian and emergent vegetation would be planted on the benches of setback levees. Large woody material, such as tree trunks and stumps, could be anchored into constructed low benches or into existing riprapped levees to provide similar habitat functions.

3.6.2.6 Riparian Habitat Restoration (CM7)

Riparian habitat restoration is anticipated to occur primarily in association with the restoration of tidal and nontidal marsh habitat, channel margin habitat, and seasonally inundated floodplains. For all action alternatives except potentially Alternative 8, 5,000 acres of riparian habitat would be restored. Implementation of Alternative 8 would result in the restoration of 5,000 acres or a number to be determined.

Although specific locations have not been identified, suitable soils for restoration—i.e., those that would allow riparian forest and scrub to occur between high marsh and herbaceous upland habitats—are expected to be most extensive in the Cosumnes/Mokelumne, east ,west, and south Delta areas. Most of the riparian restoration in the Plan Area is expected to be in restored seasonally inundated floodplain habitat and associated with tidal restoration in Conservation Zone 7, where only 4.5% is currently protected. Restoration would also be associated with tidal habitat restoration and channel margin enhancement in Conservation Zones 1–6.

Restoration of riparian habitat will be a component of tidal habitat restoration, seasonally inundated floodplain restoration, and channel margin habitat enhancement projects; therefore, the schedule for planning, site acquisition, environmental compliance, and implementation of riparian restoration actions is the same as the implementation schedule for those tidal, floodplain, and channel margin habitat restoration actions. The amount of riparian habitat restored varies greatly among the three restoration types. The preponderance of the 5,000 acres of riparian habitat to be restored will be performed in conjunction with seasonally inundated floodplain restoration and tidal habitat restoration in the south Delta.

Priority for riparian habitat restoration would be given to sites that provide a range of environmental gradients, increase connectivity between preserve lands and movement corridors between patches of existing habitat, promote the regeneration and establishment of native plants such as willows and cottonwoods, and provide additional habitat for aquatic and terrestrial species with very limited distributions. Riparian restoration is anticipated to occur in association with the restoration of tidal and nontidal marshes, seasonally inundated floodplains, and channel margin enhancement. Riparian habitat restoration associated with tidal habitat and channel margins would consist mostly of long and narrow patches, while riparian associated with restored floodplains would be in larger swaths (typically more than 100 acres).

Development of the riparian habitat restoration sites would also reflect the wide diversity, in terms of vegetation composition and structure, that can be found among riparian communities. For example, willow thickets and mature riparian gallery forests represent riparian communities at very different ecological stages. Individual riparian species may occur in all or only a subset of riparian communities.

Site Preparation, Earthwork, and Other Site Activities

Site preparation could require clearing and grubbing, demolition of existing structures, surface water quality protection, dust control, establishment of storage areas and stockpile areas, temporary utilities and fuel storage, and erosion control.

Earthwork activities for development of the riparian habitat areas would be minimal, focusing on removal of riprap and minor landform modifications to restore water circulation. The primary activities would entail either natural establishment or planting of riparian vegetation, irrigation and maintenance of plantings, and control of nonnative species.

Native riparian vegetation would be planted if site-specific restored floodplain conditions indicate that such plantings would substantially increase the establishment of valley/foothill riparian habitat. Elderberry shrubs would be a component of such plantings to provide habitat for valley elderberry longhorn beetle.

Irrigation systems and water supplies could be necessary to establish native vegetation. Irrigation system construction could include placement of aboveground or belowground irrigation piping. Erosion and dust control measures would be implemented during construction as described in Appendix __, *Environmental Commitments*.

3.6.2.7 Grassland Communities Restoration (CM8)

Under all action alternatives except potentially Alternative 8, 2,000 acres of grassland within Conservation Zones 1, 8, and 11 would be restored. Some of the acreages would be included as part of tidal habitat restoration (CM4) and agricultural land protection (CM3). Implementation of Alternative 8 would result in the restoration of 2,000 acres or a number to be determined.

The restored grassland habitat would be designed and situated such that it supports habitat for associated covered species, improves connectivity among existing patches of grassland and other natural habitats, and improves the native wildlife habitat functions of transitional uplands adjacent to BDCP restored tidal habitats. Anticipated actions to restore grassland habitat, as appropriate to site-specific conditions, would include, but not be limited to, those listed below.

- Acquiring lands, in fee title or through conservation easements, with site characteristics (e.g., soils, proximity to high-value habitat areas) that support restoration of high–value grassland.
- Restoring grassland by sowing native species using a variety of techniques (e.g., seed drilling, native hay spreading, plugs). Seed sown on the sites would be from collections or from seed collected at the nearest practicable natural site with similar ecological conditions. Restoration actions may require the recontouring of graded land as appropriate and should generally be targeted to parcels with low soil fertility and that have not been used for intensive crop production. These areas could also function as seed nurseries to produce seed that could be planted on other portions of the site.
- Potentially restoring grazing grassland habitat to modify its vegetation; this is a complex management problem if the grassland contains native bunchgrasses, geophytes, vernal pool complex, or alkali seasonal wetland complex and would require site- and pasture-specific solutions like those described in Section 3.6.2.8, *Vernal Pool Complex Restoration (CM9)*.

The implementation schedule assumes that all grassland habitat restoration actions would be implemented between years 3 and 30. A total of 1,000 acres of grassland would be restored in the near-term implementation period, 250 acres in the early long-term implementation period, and 750 acres in the late long-term implementation period. The implementation schedule assumes that site acquisition, planning, and regulatory compliance–related activities for the first 250 acres of grassland restoration to be completed in year 3 are initiated in the first year following BDCP authorization, and those implementation elements require a total of 2 years to complete. All subsequent restoration increments also require a 2-year period to complete site acquisition, planning, and regulatory compliance prior to implementing restoration actions.

Site Preparation, Earthwork, and Other Activities

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.2.8 Vernal Pool Complex Restoration (CM9)

Under all action alternatives except potentially Alternative 8, vernal pool complex in Conservation Zones 1, 8, and 11 (Figure 3-1) would be restored to achieve no net loss of this habitat type. Implementation of Alternative 8 would result in the restoration of 600 acres or a number to be determined, and no net loss. Restoration of vernal pool complex habitat would offset vernal pool loss resulting from BDCP covered activities. Restored vernal pool complex would be built off of the existing reserve system, and in conjunction with protection of 600 acres of existing vernal pool complex, contribute to the establishment of a large, interconnected vernal pool reserve system in the Plan Area. Implementation of Alternative 8 would result in the protection of 600 acres or a number to be determined.

The amount of vernal pool complex restoration will be determined in implementation based on the following.

- If restoration is completed (i.e., restored habitat meets all success criteria) prior to impacts, then 1.0 acre of vernal pool complex will be restored for each acre impacted (1:1 ratio).

- If restoration takes place concurrent with impacts (i.e., restoration construction is completed, but restored habitat has not met all success criteria, prior to impacts occurring), then 1.5 acres of vernal pool complex will be restored for each acre impacted (1.5:1 ratio).

In either case, the density of wetted area of vernal pool must be the same as or greater than that lost to covered activities to ensure no net loss of wetlands and wetland function. In lieu of restoration, an equivalent amount of vernal pool restoration credit may be purchased at a USFWS- and DFG-approved vernal pool mitigation bank if the bank occurs in the Plan Area and meets the site selection criteria described below.

The extent of restored vernal pool complex would encompass a matrix of grassland or alkali seasonal wetland complex in which vernal pools, swales, and saturated alkaline soil areas are interspersed and that include habitat gradients that vary by Conservation Zone. These gradients would comprise tidal freshwater or tidal brackish emergent wetlands, adjoining transitional upland habitat, grassland, alkali seasonal wetlands, and agriculture. The restored areas would be distributed throughout the three Conservation Zones in a manner that would achieve conservation objectives for associated covered species. The BDCP Implementation Office would select specific restoration sites within these Conservation Zones in consideration of the suitability of available lands for restoration, their biological value, and practicability. Habitat would be restored on sites that historically supported vernal pool complex, thus ensuring that soil types that support vernal pools are present.

The implementation schedule for this conservation measure assumesthat all vernal pool complex habitat restoration actions would be implemented between years 2 and 15. A total of 116 acres of vernal pool complex would be restored in the near-term implementation period, 42 acres in the early long-term implementation period, and 42 acres in the late long-term implementation period. The implementation schedule assumes that site acquisition, planning, and regulatory compliance–related activities for the first 58 acres of vernal pool complex restoration to be completed in year 2 are initiated before BDCP authorization, and those implementation elements require a total of 3 years to complete. All subsequent restoration increments also require a 3-year period to complete site acquisition, planning, and regulatory compliance prior to implementing restoration actions.

Vernal pool restoration sites would meet the following site selection criteria

- The site is in Conservation Zone 1, 8, or 11.
- The site has evidence of historical vernal pools based on soils, remnant topography, remnant vegetation, historical aerial photos, or other historical or site-specific data.
- The site supports suitable soils and landforms for vernal pool restoration.
- The adjacent land use is compatible with restoration and long-term management to maintain natural community functions (e.g., not adjacent to urban or rural residential areas).

Restoration sites would be acquired, in fee-title or through conservation easements, and protected in perpetuity. Each restoration site would be managed and maintained consistent with the site-specific restoration plan until restoration success criteria have been met, and would be managed in perpetuity. Acquisition of vernal pool restoration sites will be prioritized based on the following criteria.

- Contribution to establishment of a large, interconnected vernal pool complex reserve system (e.g., adjacency to existing protected vernal pool complex).

The following restoration techniques would be implemented.

- Remnant natural vernal and swale topography will be restored by excavating or recontouring historical vernal pools and swales to natural bathymetry based on their characteristic visual signatures on historical aerial photographs, other historical data, and the arrangement and bathymetry of vernal pools and swales at a reference site.
- The reference site will consist of existing nearby, natural (i.e., unmodified by human activities) vernal pool complex supporting covered vernal pool species.
- To provide for high-functioning habitat, restored vernal pool complex will be vegetated with hand-collected seed from appropriate areas in the same conservation zone. Soil inoculum will not be used to establish vernal pool plants and animals in these conservation zones unless the source vernal pools are free of perennial pepperweed, waxy mannagrass, swamp timothy, and Italian ryegrass. These nonnative species establish more rapidly than native species, and create dense populations that are likely to reduce the establishment success of the native plants and also create thatch problems in the vernal pools (see Barona et al. 2007 for problems of nonnative species thatch buildup due to soil inoculum).
- Propagules (cysts) of covered vernal pool invertebrate species will not be introduced into restored vernal pools through the use of soil inoculum unless the source vernal pools are free of perennial pepperweed, swamp timothy, and Italian ryegrass. . Vernal pool invertebrates are expected to be passively introduced into the restored vernal pools through the movement of other animals from pool to pool. Propagules (cysts) of covered vernal pool species will not be introduced through use of soil inoculums, in order to ensure against introduction of invasive species such as perennial pepperweed, swamp timothy, and Italian ryegrass.

Additionally, The BDCP Implementation Office would protect at least two currently unprotected occurrences of Heckard's peppergrass and at least two currently unprotected occurrences of San Joaquin spearscale in Conservation Zones 1,8, or 11. If lands with unprotected occurrences are unavailable for acquisition, plant occurrences will be established in restored vernal pool complex using seed from the same conservation zone as the restored vernal pool complex. The methods for establishing each occurrence, as well as monitoring methods, success criteria, and contingency measures, would be detailed in the site-specific restoration plan.

The implementation schedule for this conservation measure assumes that all vernal pool complex habitat restoration actions would be implemented between years 2 and 15. A total of 116 acres of vernal pool complex would be restored in the near-term implementation period, 42 acres in the early long-term implementation period, and 42 acres in the late long-term implementation period. The implementation schedule assumes that site acquisition, planning, and regulatory compliance–related activities for the first 58 acres of vernal pool complex restoration to be completed in year 2 are initiated before BDCP authorization, and those implementation elements require a total of 3 years to complete. All subsequent restoration increments also require a 3-year period to complete site acquisition, planning, and regulatory compliance prior to implementing restoration actions.

Site Preparation, Earthwork, and Other Activities

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.2.9 Nontidal Marsh Restoration (CM10)

Under all action alternatives except potentially Alternative 8, 400 acres of nontidal freshwater marsh within Conservation Zones 2 and 4 (Figure 3-1) would be restored. Implementation of Alternative 8 would result in the restoration of 400 acres or a number to be determined. Restored habitat would be distributed in patches of at least 25 acres and associated with occupied giant garter snake habitat within the proposed 1,000-acre giant garter snake preserves designed to enhance the Coldani Marsh/White Slough and Yolo Basin/Willow Slough giant garter snake populations.

Restored nontidal wetlands would also be designed and managed to support other native wildlife functions including waterfowl foraging, resting, and brood habitat and shorebird foraging and roosting habitat. Restored habitat would include preserved transitional upland habitat to provide upland habitat for giant garter snakes and western pond turtles and nesting habitat for waterfowl.

Though it is not a conservation target, patches of existing nontidal freshwater perennial emergent wetland present on lands acquired to protect other natural communities would also be protected and enhanced to improve habitat functions and values for covered and other native species.

Anticipated actions to restore nontidal freshwater perennial emergent wetland, as appropriate to site-specific conditions, would include those listed below.

- Acquiring lands, in fee-title or through conservation easements, suitable for restoration of nontidal freshwater perennial emergent wetland.
- Securing sufficient annual water to sustain habitat function.
- Creating complex habitat with open water and edge habitats, tule-dominated vegetation, bank slopes with variable angles, and adjacent upland with open canopy and elevational gradient to promote mammal burrows and higher elevation refugia.
- Establishing connectivity with the existing water conveyance system and habitats occupied by giant garter snakes.
- Allowing for the natural establishment of marsh vegetation.
- Site preparation, planting of native marsh vegetation, and maintenance of plantings.
- Control of nonnative plants.

Once established, it is expected that restored nontidal freshwater perennial emergent wetland would be self-sustaining and would be monitored to determine if subsequent management actions may be required to ensure successful regeneration of native marsh plant species.

Nontidal freshwater perennial emergent wetland would be established where soils and hydrology are suitable through conversion of existing agricultural lands to a freshwater marsh–perennial aquatic complex. Restored marshes would occur in association with adjacent grassland, pastureland, or cultivated uplands. Marsh vegetation would be allowed to naturally reestablish along the edges of perennial aquatic habitat, but would also be planted as needed to facilitate marsh development and to manage species composition. The development of marsh vegetation would be monitored to determine if nonnative vegetation needs to be controlled to facilitate the establishment of native marsh vegetation or if restoration success could be improved with supplemental plantings of native species. If indicated by monitoring, nonnative vegetation control measures and supplemental plantings would be implemented.

The implementation schedule for this conservation measure assumesthat all nontidal freshwater marsh restoration actions would be completed by year 9 in the near-term implementation period. The restored nontidal freshwater marsh will be designed specifically to support giant garter snake habitat and would be completed in the near-term implementation period to provide benefits for this endangered species as early as practical. The implementation schedule assumes that site acquisition, planning, and regulatory compliance–related activities for each 100 acres of restoration require 2 years to complete, with the restoration actions being completed in the third year.

Site Preparation, Earthwork, and Other Activities

Grading would be required to establish an elevational gradient to support both open water perennial aquatic habitat intermixed with shallower marsh habitat.

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.2.10 Natural Communities Enhancement and Management (CM11)

This conservation measure applies to all BDCP protected and restored habitats and is implemented at the time each parcel of land is acquired for the BDCP conservation lands system.

Site-Specific Management Plans

Under all action alternatives, the BDCP Implementation Office would prepare and implement management plans for protected natural communities and covered species habitats found within those communities. Management plans may be prepared for specific reserves or for multiple reserves within a specified geographic area. Management plans would provide the information necessary to guide habitat enhancement and management actions necessary to achieve the biological objectives established for the conserved lands addressed by each plan. Based on the assessment of existing site conditions (e.g., soils, hydrology, vegetation, occurrence of covered species) and site constraints (e.g., location, size), and depending on biological objectives of the conserved lands, management plans would specify measures for enhancing and maintaining habitat as appropriate. Management plans would be periodically updated to incorporate changes in maintenance, management, and monitoring requirements as they may occur over the term of the BDCP.

Within 2 years of acquisition of conserved parcels, the Implementation Office would conduct surveys to collect the information necessary to assess the level of ecological condition and function of conserved species habitats and would identify habitat enhancement actions to be implemented to enhance habitat functions for the target covered species and any subsequent ongoing management actions that are necessary to maintain habitat functions over time. Survey data must also include information necessary to assess the effectiveness of enhancement and management measures.

Management and enhancement actions would be implemented for the following natural communities.

- Tidal aquatic and wetland.
- Nontidal aquatic and wetland.
- Riparian.
- Grasslands and associated seasonal wetland.

- Inland dune scrub.
- Agricultural lands and managed wetlands.

Results of effectiveness monitoring of enhancement and management actions will provide the information necessary to identify future changes in management of conserved lands to ensure that biological objectives are achieved over the term of the BDCP.

Site Preparation, Earthwork, and Other Activities

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.2.11 Monitoring and Research

As part of the BDCP, a monitoring and research program would be implemented to provide a means by which information necessary to implement the BDCP over time would be collected and compiled. The adaptive management decision-making process would be informed by the best available science.

Several types of monitoring would be conducted.

- **Preconstruction surveys** are conducted prior to implementation of certain covered activities and conservation measures that may affect covered species and their habitats. Survey results would be used to determine if covered species are present and likely to be affected by the activities and, if so, the types of measures to be taken to avoid and minimize impacts.
- **Construction monitoring** is conducted during the construction of various proposed facilities (both covered activities and conservation measures) to ensure that avoidance and minimization measures are properly implemented where covered species have been identified at or adjacent to a construction site.
- **Compliance monitoring** is initiated following construction to ensure that conservation measures are meeting specified permit terms, to track progress of implementation in accordance with established timetables, and to monitor success of measures through use of thresholds established as adaptive management "triggers" in the BDCP. Compliance and effectiveness of individual conservation measures would be measured through use of specific requirements, metrics, and targets defined prior to implementation.

Additional information and details related to the monitoring and research program can be found in Section 3.6 of the BDCP.

3.6.2.12 Adaptive Management

The BDCP Adaptive Management Program would be developed on the concept that, as new information and insight are gained during implementation of the Plan, adjustments can be made to the conservation actions to further advance the BDCP goals and objectives. The adaptive management process is designed to use new information (i.e., contributions to the knowledge base) to inform a systematic and integrated critical review, at regular intervals, of the entire BDCP Conservation Strategy (BDCP Chapter 3), including BDCP objectives, conservation measures, hypotheses relating to predicted outcomes, and targets. As the knowledge base expands and biological models are revised, changes may be made to the BDCP objectives and associated hypotheses, targets, and monitoring metrics. The Science Manager of the BDCP Implementation

Office would be responsible for ensuring that the Adaptive Management Program is focused on the achievement of BDCP biological goals and objectives and that the program draws from the best scientific and commercial information available to support adaptive management decisions.

Additional information and details related to the monitoring and research program can be found in Section 3.7 of the BDCP.

3.6.3 Conservation Components Related to Reducing Other Stressors

The BDCP has identified several issues, beyond water exports and habitat conditions, that affect the survival of covered species in the Delta. These other stressors include exposure to contaminants, competition, predation and changes to the ecosystem caused by nonnative species, entrainment at water intake pumps not operated by SWP and CVP, and fish passage. The proposed BDCP components related to reducing other stressors are described below. These components would be implemented under all action alternatives.

3.6.3.1 Methylmercury Management (CM12)

This measure would minimize the potential for other BDCP habitat conservation activities—especially the conversion of managed wetlands to tidal wetlands—to increase the bioaccumulation of methylmercury in covered and other native species. Specifically, the measure would minimize adverse effects of methylmercury on white sturgeon, North American green sturgeon, and Sacramento splittail. It would minimize and potentially reduce adverse effects on salt marsh harvest mouse, Suisun shrew, and California least tern in Suisun Marsh.

As part of the measure, design elements would be defined to minimize conditions conducive to generation of methylmercury in restored areas. Additionally, adaptive management strategies would be defined to monitor and minimize actual post-restoration mobilization of methylmercury.

The Adaptive Management and Monitoring Program will prepare and implement a Mercury Management Plan for BDCP restoration activities under CM4. This conservation measure would implemented as part of the tidal habitat restoration design schedule The plan will discuss methylmercury management measures described below, and will require that each measure is considered for each restoration area. The plan will require that each measure is implemented, or that cause is shown why implementation is not appropriate, and that this be reported in permitting and implementation documents for each enhancement or restoration project that entails creation of applicable natural communities. The plan will also include a QA/QC program specifying sampling procedures, analytical methods, data QA/QC review requirements, a QA/QC Manager, and data management and reporting procedures. Each site-specific plan will be reviewed and approved by the QA/QC Manager.

Management measures would include soil mercury characterization (which is necessary to inform restoration design, post-restoration monitoring, and adaptive management strategies) and adaptive management and post-restoration monitoring. Mitigation and post-construction monitoring measures specified in a site-specific mercury management plan will be mandatory if monitoring data shows levels of methylmercury exceeding 0.06 nanograms per liter (unfiltered sample).

Potential minimization and mitigation measures include minimizing microbial methylation by reducing loads of organic matter, designing areas to enhance photodegradation, remediating for sulfur-amending sediments with iron, and designing restoration areas to cover mercury-containing sediments through grade changes.

3.6.3.2 Nonnative Aquatic Vegetation Control (CM13)

The BDCP Implementation Office would control growth of Brazilian waterweed, water hyacinth, and other nonnative submerged and floating aquatic vegetation in BDCP tidal habitat restoration areas. To implement this measure, the BDCP would apply existing control methods used by the Department of Boating and Waterways, including application of herbicides and mechanical removal. Site-specific conditions and the intended goal would dictate the specific method of removal. Application of herbicides and other means to control nonnative aquatic vegetation would be timed to eliminate or minimize potential adverse effects on covered species.

This measure is hypothesized to reduce predation mortality on covered species by reducing habitat for nonnative predatory fish and by increasing turbidity levels. Increased turbidity could also support delta and longfin smelt foraging abilities. Control of nonnative aquatic vegetation could also support access to additional rearing habitat for covered species, as well as increased food availability stemming from greater light levels for phytoplankton growth.

The BDCP Implementation Office would monitor the effectiveness of BDCP-funded vegetation control methods and adjust control strategies and funding levels through the BDCP adaptive management process.

The implementation schedule for this conservation measure assumesthat nonnative aquatic vegetation–control actions would be required at each tidal habitat restoration site immediately following restoration, and in some cases sites may require treatment prior to initiating restoration. Because current nonnative aquatic vegetation–control methods are dependent on the use of herbicides, the implementation schedule assumes 1 year to complete planning and environmental compliance for the first tidal habitat restoration to be initiated in year 2 and that nonnative–aquatic vegetation control would begin following restoration of tidal exchange. Thereafter, the schedule assumes that planning and environmental compliance processes would be streamlined, requiring no more than 2 years to complete, and would run concurrent with planning and compliance elements conducted for each of the subsequent tidal habitat restoration actions.

3.6.3.3 Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14)

This measure would maintain dissolved oxygen levels above levels that impair covered fish species in the Stockton Deep Water Ship Channel when covered species are present. The BDCP would operate and maintain an oxygen aeration facility in the Stockton Deep Water Ship Channel to increase dissolved oxygen concentrations between Turner Cut and Stockton to meet Total Maximum Daily Load (TMDL) objectives established by the Central Valley Water Board (above 6.0 mg/L from September 1 through November 30 and above 5.0 mg/L at all times). The existing aeration facility would be modified as necessary and, if necessary, additional aerators and associated infrastructure would be added to optimize oxygen delivery to the river, contingent upon results of an ongoing demonstration project conducted by DWR and effectiveness monitoring during implementation.

Results suggest that the aeration facility is effective at raising dissolved oxygen levels in much of the channel. Higher dissolved oxygen levels are thought to reduce delay and inhibition of migration and reduce physical stress and mortality in covered fish species.

The Implementation Office would develop annual work plans in coordination with the Fishery Agencies that specify the extent of dissolved oxygen improvements to be implemented and would be responsible for monitoring the effectiveness of dissolved oxygen enhancement measures in improving dissolved oxygen levels. The Implementation Office would use effectiveness monitoring results to determine whether aeration facility operations result in measureable benefits to covered species and would adjust funding levels, oxygen diffuser methods, or other related aspects through the BDCP adaptive management process.

The implementation schedule for this conservation measure assumes the current Stockton Deep Water Ship Channel dissolved oxygen diffuser demonstration project would be implemented immediately following BDCP authorization (i.e., continued operation). The implementation schedule assumes the dissolved oxygen diffuser technology would need to be modified to provide substantial biological benefits for the covered fish species. The implementation schedule also assumes completion of a demonstration study by the end of year 1 that would provide guidance on how to modify the diffusers. Additional planning, coordination, environmental compliance, and construction are assumed to require an additional 2 years, and assuming modifications are necessary, the modified dissolved oxygen diffusion facilities would become operational in year 4, with operations continuing over the term of the BDCP.

3.6.3.4 Predator Control (CM15)

This measure would reduce local effects of predators on covered fished species by conducting predator control in areas with high predator density. The Implementation Office would identify predator *hot spots* and would adopt control methods including the removal of predator hiding spots, modification of channel geometry, targeted removal of predators, and other focused methods as dictated by site-specific conditions and the intended outcome or goal. Preference for which hot spots to address would be given to areas of high overlap with covered fish species, such as major migratory routes or spawning and rearing habitats.

Site-specific control plans would be developed in consultation with the Fishery Agencies, and would include expected benefits, methods, and a monitoring design that would provide information necessary to determine the effectiveness of the action. The Implementation Office, in consultation with the Fishery Agencies, would use results of effectiveness monitoring to determine whether the actions result in measurable benefits to covered fish species and to identify adjustments to funding levels, methods, or other related aspects of the program that would improve its biological effectiveness.

The implementation schedule for this conservation measure assumes that predator control actions to remove artificial structures and abandoned boats from Delta channels would require 2 years of planning and environmental compliance, with actions being implemented in year 3. Authorizations to implement actions to remove nonnative predatory fish from specific locations are assumed to be completed in the first year following BDCP authorization and implemented in year 3. Following the first year of their implementation, predator control actions are assumed to be implemented annually over the term of BDCP.

3.6.3.5 Nonphysical Fish Barriers (CM16)

The purpose of this conservation measure is to improve the survival of outmigrating juvenile salmonids by using nonphysical barriers to direct them away from channels in which survival is lower. The BDCP Implementation Office would install nonphysical barriers at the junction of channels with low survival of outmigrating juvenile salmonids to deter fish from entering these channels. Nonphysical barrier placement locations would include the Head of Old River, the Delta Cross Channel, and Georgiana Slough, and could possibly include Turner Cut, Columbia Cut, the Delta Mendota Canal intake, and Clifton Court Forebay. Other locations may be considered in the future by the Implementation Office if, for example, future research demonstrates differential rates of survival in Sutter and Steamboat Sloughs relative to the mainstem Sacramento River, or in the Yolo Bypass relative to the mainstem Sacramento River. Nonphysical barriers would include a combination of sound, light, and bubbles. Nonphysical barriers would be installed and operated during October to June or when monitoring by the Fishery Agencies determines that salmonid smolts are present in the areas where barriers are to be installed. Nonphysical barrier placement may also be accompanied by methods to reduce local predator abundance described in Section 3.6.3.4, *Predator Control (CM15)*, if monitoring finds that barriers attract predators. Barriers would be removed and stored offsite while not in operation.

The BDCP Implementation Office would monitor this measure to assess its effectiveness and use results to determine whether operations of nonphysical barriers result in measureable benefits to juvenile salmonids and to identify adjustments to funding levels, methods, or other related aspects that would improve the measure's effectiveness.

The existing nonphysical fish barrier serving as a pilot project at the head of Old River is assumed to continue to be operated immediately following BDCP implementation. Planning and compliance activities for placing barriers at the Delta Cross Channel and Georgiana Slough are assumed to be initiated in the year following BDCP approval, requiring 2 years to complete, followed by construction and operation in the third year. The schedule assumes that up to four additional barriers may be constructed and operated if studies indicate substantial benefits for the covered fish species. The implementation schedule assumes 2 years of studies will be conducted following BDCP authorization and, assuming the studies indicate the placement of barriers will be beneficial, that 2 years will be required for planning and compliance and 1 year for construction as described above for the initial barriers.

3.6.3.6 Illegal Harvest Reduction (CM17)

The purpose of this measure is to reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta, bays, and upstream waterways. The BDCP will provide funding over the term of the BDCP to increase the enforcement of fishing regulations in the Delta and bays to reduce illegal harvest of covered salmonids and sturgeon. The BDCP Implementation Office will provide funds to DFG to hire and equip 17 additional Game Wardens and 5 supervisory and administrative staff in support of the existing field wardens assigned to the Delta-Bay Enhanced Enforcement Program over the term of the BDCP.

The Implementation Office will coordinate with DFG to adjust enforcement strategies and funding levels through the BDCP adaptive management process as appropriate, based on review of Delta-Bay Enhanced Enforcement Program annual reports.

The implementation schedule assumes that planning and coordination with DFG and the existing Delta-Bay Enhanced Enforcement Program (DBEEP) necessary to expand DBEEP staffing would immediately follow BDCP authorization such that the conservation measure is implemented by the end of year 2.

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3.6.3.7 Conservation Hatcheries (CM18)

This conservation measure would establish new conservation propagation programs for delta and longfin smelt and expand existing programs. The BDCP Implementation Office would support: (1) the development of a delta and longfin smelt conservation hatchery by USFWS to house a delta smelt refugial population and provide a source of delta and longfin smelt for supplementation or reintroduction, if deemed necessary by the Fishery Agencies; and (2) the expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California, Davis (UC Davis) Fish Conservation and Culture Laboratory (FCCL) to serve as a population safeguard in case of a catastrophic event in the wild.

The new facility proposed by USFWS would house genetically managed refugial populations of delta and longfin smelt. Further, the facility would provide fish to supplement the wild population and provide fish stocks for reintroduction, as necessary and appropriate. State-of-the-art genetic management practices would be implemented to avoid hatchery-produced fish becoming genetically different from wild fish. The facility would be designed with the ability to add other species if necessary in the future. Due to space limitations, the facility as planned would consist of two sites: a science-oriented genetic refuge and research facility on the edge of the Sacramento River, and a larger supplementation production facility nearby. Specific rules would be established to discontinue housing refugial populations of delta and longfin smelt at the hatchery if and when populations of these species are considered recovered by the Fishery Agencies.

At the UC Davis FCCL and the Genomic Variation Laboratory (GVL), genetic management practices would be implemented to maintain wild genetic diversity, minimize genetic adaptation to captivity, minimize mean kinship, and equalize family contributions. Furthermore, genetic monitoring of wild populations would be undertaken to minimize risks such as genetic swamping from the hatchery population, reduction in effective population size, and changes in the census population-to-breeder population ratio over time.

The BDCP Implementation Office would enter into binding Memoranda of Agreement. In addition, if and when populations of these species are considered recovered by the Fishery Agencies, the Implementation Office would terminate funding for the propagation of the species and either fund propagation of additional BDCP covered fish species, if necessary and feasible, or deobligate funds to this conservation measure and reallocate them to augment funding for other conservation measures identified in coordination with the Fishery Agencies through the BDCP adaptive management process.

The implementation schedule for this conservation measure assumes that site acquisition, planning, and environmental compliance necessary for construction of the new DFG conservation hatchery facility will require 3 years following BDCP authorization, that an additional 2 years would be necessary for construction, and that the facility will become operational in year 6. Planning and environmental compliance necessary for the expansion of UC Davis conservation hatchery are assumed to be initiated before BDCP authorization such that the facility expansion is completed by the end of the second year of BDCP implementation, becoming operational in the year 3 of implementation. Both USFWS and the UC Davis facilities are assumed to be operated over the term of the BDCP once they have become operational.

3.6.3.8 Urban Stormwater Treatment (CM19)

This conservation measure would fund local government projects to reduce pollutant discharges in stormwater. The BDCP Implementing Entity will provide funding to the Sacramento Stormwater Quality Partnership, and/or counties and cities whose stormwater contributes to Delta waterways (hereafter "stormwater entities") under National Pollutant Discharge Elimination System (NPDES) MS4 stormwater permits to implement actions from and in addition to their respective stormwater management plans. Actions in addition to those in existing plans/programs will be implemented if they are expected to benefit covered species.

Potential types of actions that could be funded under this measure include, but are not limited to:

- construction of retention/irrigation holding ponds for the capture and irrigation use of stormwater;
- design and establishment of vegetated buffer strips to slow runoff velocities and capture sediments and other pollutants;
- design and construction of bioretention systems (grass buffer strips, sand bed, ponding area, mulch layer, planting soil, and plants) to slow runoff velocities and for removal of pollutants from stormwater;
- construction of stormwater curb extensions adjacent to existing commercial businesses that are likely to contribute oil and grease runoff;
- establishment of stormwater media filters to remove particulates and pollutants, such as that located at the American Legion Park Pump Station in Stockton;
- provisioning of funds for moisture monitors to be installed during construction of sprinkler systems at commercial sites that will eliminate watering when unnecessary; and
- providing support for establishment of on-site infiltration systems in lieu of new storm drain connections for new construction, such as pervious pavement in place of asphalt and concrete in parking lots and along roadways, and downspout disconnections to redirect roof water to beds of vegetation or cisterns on existing developed properties, including residential.

3.6.3.9 Recreational Users Invasive Species Program (CM20)

This conservation measure would use education and inspections to reduce the risk of invasive species introduction on recreational vessels. It would be developed in collaboration with DFG who would likely also implement the program in concert with existing efforts of this kind, which are currently managed under the DFG's Aquatic Invasive Species program.

The BDCP Implementing Entity would provide funds over the term of the BDCP to support implementation of the following actions to reduce the risk of future introductions of non-native aquatic organisms from recreational watercraft:

- Fund and support the California Department of Food and Agriculture (CDFA) and DFG to operate additional recreational watercraft and trailer inspection stations and cleaning stations (hereafter, "spot check stations") on roads at California borders that currently do not have inspection stations to increase detection of aquatic invasive species. These spot check locations will assist in "sealing off" California from boats exiting the Colorado River, which is infested with quagga mussels. Spot check stations will be located, in order of priority, at: (1) Needles Highway southbound; (2) Highway 95 southbound at Arrowhead Junction; (3) State Route 95, southbound at Needles Bridge; (4) Havasu Lake Road near the west shore of Lake Havasu; (5) Highway 95 at Vidal Junction; (6) Agnes Wilson Bridge westbound; and (7) Highway 95 southbound north of Blythe. Semi-permanent inspection stations will be established and operated on busy boat traffic days.

- Provide wash stations with sufficient cleaning abilities to kill aquatic invasives on watercraft, trailers, and other equipment leaving water bodies within California that are infested with zebra or quagga mussels. Wash stations will be strategically placed at boat ramps of each water body and owners will be encouraged to clean their watercraft and trailers upon leaving the water body. If other water bodies in California become infested with zebra or quagga mussels during the term of the BDCP, the BDCP Implementing Entity will provide funding over the term of the BDCP for additional wash stations.

- Fund the DFG Invasive Species Program to improve Delta-specific outreach and education on the effects, prevention, and control of non-native species in the Delta. Funding will support the following specific actions:
  - Add a half-time position dedicated to the DFG Invasive Species Program that would: (1) develop and distribute printed material (posters, brochures, and articles) for specific industry sectors and user groups (such as boat charter operators, marinas, angling guides, fishing tournament organizers, bait shops, aquarium stores, and dredging contractors); (2) develop permanent interpretive displays at marinas, boat ramps, boat cleaning stations (see #2 above), and fishing sites; and (3) supervise two teams of one DFG scientific aide and one DFG fish and wildlife technician to educate boaters;
  - Fund two teams of one scientific aide and one fish and wildlife technician to rove boat access areas throughout the Delta from March-November each year to educate boaters on the effects, prevention, and control of non-native species, inspect boats, demonstrate washing techniques for potentially infested watercraft, and provide information on other spread prevention resources; and
  - Provide two strategically-located portable wash stations in the Delta that teams conducting outreach can use when they encounter potentially contaminated boats.

The BDCP Implementing Entity will enter into binding MOAs, contracts, or other instruments with DFG, CDFA, and the managers of the water bodies with quagga/zebra mussel infestations to implement this conservation measure. Funded entities will be responsible for implementing the scopes of work and submitting reports as specified in the agreements that demonstrate that work plans are successfully implemented.

3.6.3.10 Nonnative Predator Control (CM21)

This conservation measure would revise the recreational fishing regulations on striped bass so as to minimize striped bass predation on Delta fishes in selected areas critical, especially to juvenile salmonid migraton and rearing. The BDCP Implementing Entity will fund development of a pilot program to reduce the size limits and increase the bag limits of recreational harvest of non-native predatory species in two specific locations in the Delta "hot spots." The locations will be identified through coordination with the fish agencies and non-agency scientists familiar with several known predation "hot spots" in the Delta.

The pilot program would be proposed to the California Fish and Game Commission (CFGC) and a limited exemption from current size and bag limits would be sought to allow higher removal rates of striped bass at smaller sizes in two identified “hot spots.” Relaxing size limits is expected to allow smaller fish to be harvested, potentially before they have reached a reproductive size, thereby reducing the reproductive capacity of the population. The pilot program would run for three years and would include monitoring and assessments of non-native predator populations at the two identified “hot spots” to determine if reduced size and increased bag limits reduce the number of non-native predatory fish at each location and result in improved survival of covered species. The program plan will be developed in coordination with the Fishery Agencies and reviewed independently, possibly through the CALFED Science Program. The pilot program will include an education component to ensure that recreational fishermen know about the reduced size limits and increased bag limits at the two locations.

At the conclusion of the pilot program, a summary analysis and report will be prepared by the BDCP Implementing Entity in consultation with the DFG that makes findings and reaches conclusions regarding the effectiveness of this effort to reduce non-native predatory fish at the two locations and whether the effort had positive effects on covered species. If results of the pilot program determine that non-native predator populations are reduced to a meaningful level to covered fish species at the two locations, a full-scale program will be designed for additional “hot spots” throughout the Delta or, at the discretion of the CFGC, for the entire Delta.

If, at the two initial study locations, the full-scale program will be proposed to the CFGC. The full-scale proposal will include the factual information that supports the conclusions of the pilot program and an estimate of the expected benefits of the full-scale program to covered species based on the conclusions of the pilot program. The F&GC will have the discretion to adopt or reject the full-scale program.

In the event the CFGC decides not to adopt the full-scale program, the funding anticipated for the education component will be shifted to another other stressors program identified through the adaptive management process. In the event the adaptive management program determines that no other stressors conservation measures are available to receive the funding, the funding anticipated for education will be shifted to a habitat restoration conservation measure identified by the adaptive management program.

3.6.3.11 Mark-Selective Fisheries (CM22)

To reduce harvest of wild stocks of Chinook salmon, the BDCP Implementing Entity would produce a proposal for a full-scale mark-select fishery program that may be implemented by DFG and the Pacific Fishery Management Council (PFMC). It is common practice for salmon hatcheries to clip the adipose fin on all relaeased fish, a practice called *mark selection*. Fishermen can easily distinguish between wild and hatchery fish based on the presence/absence of the adipose fin, thereby enabling regulations that prohibit harvest of wild fish. The mark-select fishery program would include all Chinook salmon hatchery fish from both the Sacramento and San Joaquin River systems.

If DFG and PFMC choose to adopt the full-scale program, it would be funded by the BDCP at a level to allow its full implementation for 6 successive years. Implementing the program over a period of 6 years will allow time for four separate broods to return upstream. A summary report would be produced describing the program’s implementation, its degree of success or failure as reflected by monitoring results, and recommendations to improve the program regardless of its outcome.

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The program will include a proposal for integrating differences between historical datasets using fractional marking and future datasets derived from mass marking. The purpose of this element of the proposal is to ensure that, in the event that a full-scale mark-select program is implemented but is not successful in improving wild salmon stocks, the mark-select program can be terminated and its data modified to conform to the historical fractional marking data. The data integration will also be capable of converting past data from fractional marking into data sets than can be used in conjunction with data from the mark-select program if DFG and PFMC decide to continue the program at the conclusion of the sixth year.

In the event that DFG and PFMC decide not to continue the mark-select program, the funding anticipated to support a continuation of the program will be shifted to another Plan conservation measure aimed at reducing other stressors consistent with the BDCP adaptive managing process. The full-scale programs will include all Chinook salmon hatchery fish from both the Sacramento and San Joaquin River systems. The program will not be submitted to DFG or PFMC until it has been peer reviewed by hatchery experts holding positive and negative views of mark-select programs. If the adaptive management program determines that no conservation measures are available to receive the funding, the funding to support continuation of the program will be shifted to the habitat restoration conservation measure identified by the adaptive management program.

3.6.3.12 Nonproject Diversions (CM23)

Under this conservation measure the BDCP Implementing Entity would provide funding to reduce entrainment at non-project diversions. To implement this conservation measure, the BDCP Implementing Entity would support Reclamation's Anadromous Fish Screen Program and DFG's Fish Screen and Passage Program to screen non-project diversions, thereby reducing entrainment risk of covered fish species at non-project diversions. In addition, in cooperation with voluntary non-project diverters, the BDCP Implementing Entity would share costs for removing, relocating, consolidating, modifying design, and altering operations of individual non-project diversions, as appropriate, to reduce the risk of entrainment of covered fish species. Relocation and consolidation would involve moving diversions from high quality habitat for covered fish species to lower quality habitat; decisions regarding which diversions to prioritize would rely in part on existing criteria established by the Anadromous Fish Screen Program and the Fish Screen and Passage Program. In addition, DFG is expected to conduct a comprehensive study to determine the distribution of fish in the Delta relative to non-project diversions and to determine entrainment rates of at least 27 diversions throughout the Delta. If DFG monitoring is not funded, the BDCP Implementing Entity will fund a similar study to gain this information to inform prioritization.

The BDCP Implementing Entity would enter into MOAs or similar binding instruments with the Reclamation and DFG. Additionally, the BDCP Implementing Entity would enter into contracts or similar binding instruments with non-project diverters that would describe respective roles and obligations for expenditure of BDCP funding. Elements of the contracts would include a description of specific actions that would be funded by BDCP, preparation and approval of project designs, BDCP funding levels, provisions for documenting work performed, access to conduct effectiveness monitoring, and provisions for modifying or terminating the contracts.

The conservation measure could include, but is not limited to, the following methods.

- Removal of individual diversions with large impacts on covered fish species.

- Consolidation of multiple diversions to a single or fewer diversions placed in lower quality habitat to reduce entrainment of covered fish species.
- Relocation of diversions with large effects on covered species from high quality to lower quality habitat.
- Relocation of diversions to areas of lower habitat quality.
- Reconfiguration of individual diversions in high quality habitat to take advantage of small-scale distribution patterns and behavior of covered fish species relative to the location of individual diversions in the channel.
- Voluntary alteration of the daily and seasonal timing of irrigation. The practicability of this approach is dependent on the crop being grown, the season when irrigation is needed relative to season fish distribution patterns, and the diel activity patterns of the covered fish species in the area of the diversion.

3.6.3.13 Waterfowl and Shorebird Areas (CM24)

[*Note to reviewers: this is a data/information gap and will be completed as information is prepared.*]

3.6.4 Water Conveyance Operational Components

Water operations (CM1) were developed to improve aquatic habitat conditions and continue SWP and CVP Delta exports in accordance with the concepts described below. The various operations scenarios as described in Section 3.3.1.2, are defined in detail in Section 3.6.4.2.

- Provisions to limit diversions at north Delta intakes to periods when Sacramento River flows would provide fish screen sweeping velocities on the ebb tide that comply with NMFS and USFWS protective criteria for salmonids and Delta Smelt.
- Operational criteria for SWP and CVP south Delta export facilities including seasonal export limits to minimize OMR reverse flows that appear to be related to fish salvage rates at SWP and CVP south Delta export facilities, while reducing hydraulic residence times and improving south Delta water quality in summer months when San Joaquin River flows are at the lowest values of the year.
- Provisions to protect downstream habitat with bypass flow requirements that reflect historical hydrologic conditions.
- Seasonally adjusted Delta inflow and outflow to improve estuarine habitat
- Increased frequency and duration of floodplain inundation in Yolo Bypass to improve habitat conditions for covered fish species and increase transport of phytoplankton, zooplankton, and other organic food supply material from the Yolo Bypass floodplain to Cache Slough, the lower Sacramento River, the west Delta, and Suisun Bay.
- Operational criteria for Delta Cross Channel gates to improve fish migration, hydraulic residence time, and food and organic material transport while minimizing changes in water quality of SWP and CVP exports.
- Provisions for fish movement in the Sacramento River using minimal instream flows prior to diversion.

- Operational criteria to maintain sufficient Sacramento River flows at Rio Vista to minimize impacts on aquatic habitat conditions.
- Maintenance of water quality for in-Delta agricultural, municipal, and industrial water quality requirements.

3.6.4.1 Operations of Covered Activities, Associated Federal Actions, and Joint Federal and Nonfederal Actions

Covered Activities

The BDCP would guide the water conveyance operations for each covered activity described in Section 3.2.1. These include operations of existing SWP facilities and operations of new water facilities constructed as part of CM1 or CM2. However, ESA and CESA coverage for existing operation and maintenance of the SWP and coordinated operations with the CVP are addressed through separate compliance processes and not addressed in the BDCP.

The BDCP would cover operations, but not construction, of any new facility associated with the North Bay Aqueduct Alternative Intake Project. This project includes an additional intake on the Sacramento River that would operate in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The project would be used to accommodate projected future peak demand of up to 240 cfs.

Federal Actions Associated with BDCP

The activities described in this section have been designated as *federal actions associated with the BDCP*. These actions consist of certain CVP-related activities within the Delta that are authorized, funded, or carried out by Reclamation. These federal actions differ from covered activities, which encompass those BDCP actions that are the responsibility of nonfederal entities.

The CVP's Delta Division[4] facilities in the Plan Area consist of the Delta Cross Channel, the eastern portion of the Contra Costa Canal, including the Contra Costa Water District's (CCWD) diversion facility at Rock Slough; the Jones Pumping Plant (formerly Tracy Pumping Plant), the Tracy Fish Collection Facility, and the northern portion of the Delta Mendota Canal. These CVP facilities are used to convey water from the Sacramento River in the north Delta to the south Delta and to export that water from the Delta into canals and pipelines that carry it to agricultural and municipal and industrial contractors to the south and west of the Delta. These facilities are integral components of the CVP and contribute to the functional capacity of the overall system. This section describes these facilities, their operational requirements, and the actions necessary to maintain their viability. The operation and maintenance of these facilities are not only integral to the water supply system, but are also important to the BDCP Conservation Strategy and the protection and conservation of the aquatic ecosystem and covered fish species.

The existing CVP facilities described in this section would be operated under both the BDCP near-term and long-term implementation, but with differing operating criteria following completion of

[4] The Delta Division is one of several CVP divisions covering various geographical areas and facilities of the CVP; these include the American River, Friant, East Side, Sacramento River, San Felipe, West San Joaquin, and Shasta/Trinity River Divisions. The CVP Delta Division includes facilities within the Plan Area (described in this chapter) and facilities outside the Plan Area (not described in this chapter).

new facilities. The BDCP near- and long-term operational criteria and adaptive operational range are described in Section 3.6.4.2, and include descriptions of operations of CVP facilities in the Plan Area.

All operations and maintenance of CVP facilities described in this section are federal actions associated with the BDCP.

Delta Cross Channel

The Delta Cross Channel is a gated diversion channel between the Sacramento River, near Walnut Grove, and Snodgrass Slough. Flows into the Delta Cross Channel from the Sacramento River are controlled by two 60-foot-by-30-foot radial gates. When the gates are open, water flows from the Sacramento River through the cross channel to Snodgrass Slough and from there to channels of the lower Mokelumne River and into the central Delta. Once in the central Delta, the water is conveyed primarily via Old and Middle rivers to the Jones Pumping Plant by the draw of the pumps. The Delta Cross Channel operation improves water quality in the interior Delta by improving circulation patterns of good quality water from the Sacramento River towards Delta diversion facilities.

Reclamation operates the Delta Cross Channel in the open position to achieve the following:

- Improve the transfer of water from the Sacramento River to the export facilities at the SWP Banks (see description of SWP facilities) and CVP Jones Pumping Plants.
- Improve water quality in the southern Delta.
- Reduce salt water intrusion rates in the western Delta.

During the late fall, winter, and spring, the gates are often periodically closed to protect out-migrating salmonids from entering the interior Delta where they are subject to higher levels of predation and greater potential for entrainment at the CVP and SWP south Delta export facilities. When flows in the Sacramento River at Sacramento reach 20,000 to 25,000 cfs (on a sustained basis) the gates are closed to reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates. See Section 3.6.4.2 for a description of operations of the Delta Cross Channel gates under the BDCP to provide for protection of salmon in conjunction with water conveyance.

C.W. Jones Pumping Plant

The CVP and SWP use the Sacramento River, San Joaquin River, and Delta channels to transport water to pumping plants located in the south Delta. The CVP's Jones Pumping Plant, about 5 miles northwest of Tracy, consists of six available pumps. The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles in length. The Jones Pumping Plant has a physical capacity of 5,100 cfs and the State Water Board-permitted diversion capacity of 4,600 cfs with maximum pumping rates ranging from 4,500 to 4,300 cfs during the peak of the irrigation season and approximately 4,200 cfs during the winter nonirrigation season until construction and full operation of the proposed Delta Mendota Canal/California Aqueduct Intertie. The wintertime physical constraints on the Jones Pumping Plant operations are the result of a Delta Mendota Canal freeboard constriction near O'Neill Forebay, O'Neill Pumping Plant capacity, and the current water demand in the upper sections of the Delta Mendota Canal. See Section 3.6.4.2, for description of south Delta operations of SWP and CVP under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion.

Tracy Fish Collection Facility

At the head of the intake channel leading to the Jones Pumping Plant, Tracy Fish Collection Facility louver screens intercept fish that are then collected, held, and transported by tanker truck to Delta release sites away from the south Delta facilities. The Tracy Fish Collection Facility uses behavioral barriers consisting of primary and secondary louvers to guide entrained fish into holding tanks. The primary louvers are located in the primary channel just downstream of the trashrack. The secondary louvers are located in the secondary channel just downstream of the traveling water screen. The louvers allow water to pass through onto the Jones Pumping Plant but the openings between the slats are tight enough and angled against the flow of water in such a way as to prevent most fish from passing between them and instead enter one of four bypass entrances along the louver arrays. The holding tanks on hauling trucks used to transport salvaged fish to release sites are injected with oxygen and contain an eight parts per thousand salt solution to reduce stress on fish. The CVP uses two release sites, one on the Sacramento River near Horseshoe Bend and the other on the San Joaquin River immediately upstream of the Antioch Bridge.

Contra Costa Water District Diversion Facilities

The CCWD diverts water from the Delta for irrigation and municipal and industrial uses under CVP contract and under its own water rights. Under its CVP contract, CCWD can divert water at Rock Slough for direct use and divert water at its intake on Old River near SR4 (designated CCWD's Old River Intake) and its new intake on Victoria Canal near Middle River (designated CCWD's Middle River Intake) for either direct use or for storage. Under its own State Water Board permit and license, CCWD can divert water for direct useat Mallard Slough, and under its own Los Vaqueros water right permit, CCWD can divert water at its Old River and Middle River intakes for storagein Los Vaqueros Reservoir.

CCWD's water system includes intake facilities at Mallard Slough, Rock Slough, Old River, and Victoria Canal near Middle River (Middle River intake); the Contra Costa Canal and shortcut pipeline; Contra Loma Reservoir; the Martinez Terminal Reservoir; and the Los Vaqueros Reservoir. The Rock Slough intake facilities, the Contra Costa Canal, the shortcut pipeline, the Contra Loma Reservoir, and the Martinez Terminal Reservoir are owned by Reclamation, and operated and maintained by CCWD under contract with Reclamation. Mallard Slough Intake, Old River Intake, Middle River Intake (on Victoria Canal), and Los Vaqueros Reservoir are owned and operated by CCWD.

CCWD's operations are governed by BOs issued to Reclamation under separate Section 7 consultations (hereafter, CCWD-specific BOs). CCWD's operations are included in the project description and modeling for the long-term SWP/CVP operations BA, which resulted in the current BOs on SWP/CVP operations (USFWS 2008, NMFS 2009).

Reclamation and CCWD are currently planning two projects to modify facilities: addition of a fish screen to the Rock Slough Intake and expansion of the Los Vaqueros Reservoir.

Rock Slough Fish Screen

The Rock Slough Intake is located about four miles southeast of Oakley, where water flows into the earth-lined portion of the Contra Costa Canal. This section of the canal is open to tidal influence and continues for four miles to Pumping Plant 1, which has capacity to pump up to 350 cfs into the concrete-lined portion of the canal. Prior to completion of the Los Vaqueros Project in 1997, this was CCWD's primary diversion point. Consistent with the CVPIA and as required by the USFWS BO for the Los Vaqueros Project (USFWS 1993), Reclamation, in collaboration with CCWD, is in the process of constructing a fish screen at the Rock Slough intake. With the completion of this project, all of CCWD's Delta intakes will include positive barrier fish screens. CCWD's other intakes (Mallard Slough, Old River and the new Middle River intake on Victoria Canal) are screened.

Los Vaqueros Reservoir Expansion Project

CCWD has certified the environmental documents for an expansion of Los Vaqueros Reservoir from its current 100,000 af to 160,000 af. CCWD is in the process of completing permits and final design, and expects to begin construction in 2011, with completion of the expansion in 2012. The expansion will improve CCWD water quality, water supply reliability and emergency storage, and will have the effect of shifting CCWD diversions from drier periods to wetter periods. The expansion will not increase CCWD overall diversions from the Delta or modify any Delta facilities; operation of the expanded reservoir will continue to be governed by existing CCWD-specific BOs. The expansion will impact terrestrial habitat and species within the Los Vaqueros watershed, which is outside of the Delta; CCWD and Reclamation are currently consulting with USFWS (under Section 7) to develop a BO covering the terrestrial impacts, mitigation, and adaptive management, separate and independent from the BDCP Section 7 consultation. Reclamation would include CCWD's operations described above in the BDCP ESA Section 7 BA as part of the existing operations. CCWD is not an ESA Section 10 permit applicant under BDCP, and operation of CCWD facilities will not change under the BDCP.

Central Valley Project Diversions

The volume of water delivered by the CVP is and will continue to be variable, but in any year will be equal to the amount of water that is hydrologically available and that can be diverted under current contractual rights consistent with the terms and conditions of the BDCP Conservation Strategy and then-existing permits and regulations. Reclamation delivers water transported through facilities in the Delta to senior water rights contractors, long-term CVP water service contractors, refuges and waterfowl areas, and temporary water service contractors south of the Delta. The total volume under contract, including Level 2 refuge supplies, is approximately 3.3 MAF. Additionally, the CVP provides Level 4 refuge water totaling approximately 100,000 AF. In addition, as part of the San Joaquin River Restoration Program implementation, Reclamation anticipates submitting a petition to add a point of diversion to the State Water Board to allow rediversion of the restoration flows either upstream of or in the Delta. Moreover, in wet hydrologic conditions when CVP storage is not available, Delta is in excess conditions, water is made available under temporary contracts for direct delivery. The volume of water available for conveyance through the Delta is a result of hydrologic conditions, upstream reservoir operations, upstream demands, regulatory constraints on CVP operations, and from transfers of water from upstream water users to south of Delta water users.

See Section 3.6.4.2 for description of near-term and long-term operations of CVP and SWP under the BDCP to provide for protection of covered fish species in conjunction with water conveyance and diversion. All CVP diversions described in this section are federal actions associated with the BDCP. Water passing through the Delta associated with water transfers (e.g., Drought Water Bank and Dry Year Water Purchase Programs) is also a covered action.

Associated Maintenance and Monitoring Activities

Maintenance and replacement means those activities that maintain the capacity and operational features of the existing CVP water diversion and conveyance facilities described above including the

Delta Cross Channel, Jones Pumping Plant, Tracy Fish Collection Facility, and Contra Costa Diversion Facilities. Maintenance activities include maintenance of electrical power supply facilities; maintenance as needed to ensure continued operations and replacement of facility or system components when necessary to maintain system capacity and operational capabilities; and upgrades and technological improvements of facilities to maintain system capacity and operational capabilities.

Monitoring activities refers to those actions necessary for monitoring water quality and fisheries as conditioned by water rights permits and biological opinions, those actions undertaken as a result of the CVPIA and agreements, and any additional monitoring under the BDCP for which Reclamation is responsible. These actions include routine daily, annual or other periodic sampling of water quality constituents as well as trawls for various fish species in the Delta (including actions associated with the Interagency Ecological Program). Reclamation currently operates and maintains more than 20 monitoring stations in the Delta which provide near-realtime water quality data. As the BDCP Conservation Strategy is implemented, the nature of, and requirements for, monitoring would be expected to change.

All CVP maintenance and monitoring described in this section are federal actions associated with the BDCP, and the effects of those actions are addressed by the BDCP.

Joint Federal and Nonfederal Actions

This section describes activities that will be carried out jointly by DWR and Reclamation. These actions are categorized as covered activities under ESA Section 10 and NCCPA Section 2835 for DWR because of DWR's involvement in these joint actions. The activities identified in this section for federal actions by Reclamation are not covered activities for the purposes of the ESA Section 10(a)(1)(b) permit. These federal actions are actions that occur within the Delta that will be coordinated with DWR to support DWR's compliance with the ESA Section 10 permit. Reclamation's activities are subject to ESA Section 7, and Reclamation will consult under ESA Section 7 on those actions. The Section 7 consultation will also include other CVP operations that are not within the Plan Area.

Joint Point of Diversion Operations

Under State Water Board Decision 1641 (D-1641) (December 1999, revised March 2002), Reclamation and DWR are authorized to use/exchange diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The use of one project's diversion facility by the other project is referred to as the Joint Points of Diversion (JPOD). There are a number of requirements in D1641 that restrict JPOD to protect water quality and fishery resources.

In general, JPOD capabilities are used to accomplish four basic SWP and CVP objectives.

- When wintertime excess pumping capacity becomes available during Delta excess conditions and total SWP/CVP San Luis storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis storage may elect to use JPOD capabilities.
- When summertime pumping capacity is available at Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP south of Delta water supplies.
- When summertime pumping capacity is available at Banks or Jones Pumping Plant to facilitate water transfers, JPOD may be used to further facilitate the water transfer.

- During certain coordinated SWP/CVP operation scenarios for fishery entrainment management, JPOD may be used to shift SWP/CVP exports to the facility with the least fishery entrainment impact while minimizing export at the facility with the most fishery entrainment impact.

All in-Delta JPOD operations are included as either covered activities or federal actions associated with the BDCP and the effects of those activities/actions are addressed by the BDCP.

Operations of New Water Intake and Conveyance Facilities

DWR would own and operate the new intake and conveyance facilities and their operations would be covered activities as described in Section 3.6.4.2. Reclamation and/or the CVP Contractors would enter into agreements to wheel CVP water through the new facilities and this action by Reclamation would be an associated federal action.

All operations of new intake and conveyance facilities are included as either covered activities or federal actions associated with the BDCP and the effects of those activities/actions are addressed by the BDCP.

Transfers

State and federal laws governing water use in California promote the use of water transfers to manage water resources, particularly water shortages, provided that certain conditions of transfer are adopted to protect source areas and users. Transfers requiring export from the Delta are conducted at times when pumping and conveyance capacity at the SWP or CVP export facilities is available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with SWP and CVP operations, such that the capabilities of the projects to exercise their own water rights or to meet their legal and regulatory requirements are not diminished or limited in any way.

SWP and CVP contractors have independently acquired water and arranged for its pumping and conveyance through SWP facilities. State Water Code provisions grant other parties access to unused conveyance capacity, although SWP contractors have priority access to capacity not being used by DWR to meet SWP contract amounts.

Delta operations involving water passing through the Delta associated with water transfers are covered activities and federal actions, however, the effects on place of origin and use are not proposed for coverage.

Suisun Marsh Facilities Operations and Maintenance

The existing Suisun Marsh facilities are listed below.

- Suisun Marsh Salinity Control Gates.
- Morrow Island Distribution System.
- Roaring River Distribution System.
- Goodyear Slough Outfall.
- Various salinity monitoring and compliance stations throughout the Marsh.

Since the early 1970s, the California Legislature, State Water Board, Reclamation, DFG, Suisun Resource Conservation District (SRCD), DWR, and other agencies have engaged in efforts to preserve beneficial uses of Suisun Marsh to mitigate for potential impacts on salinity regimes associated with reduced freshwater flows to the marsh. Initially, salinity standards for Suisun Marsh were set by the State Water Board's Decision 1485 to protect alkali bulrush production, a primary waterfowl plant food. Subsequent standards set under the State Water Board's Decision-1641 reflect the intention of the State Water Board to protect multiple beneficial uses. A contractual agreement between DWR, Reclamation, DFG, and SRCD includes provision for measures to mitigate the effects of SWP and CVP operations and other upstream diversions on Suisun Marsh channel water salinity. The Suisun Marsh Preservation Agreement requires DWR and Reclamation to meet specified salinity standards, sets a timeline for implementing the Plan of Protection, and delineates monitoring and mitigation requirements.

The existing operation of the Suisun Marsh Facilities is covered for ESA and CESA compliance under the Operations Criteria and Plan (OCAP) BOs and the related consistency determination. The Suisun Marsh Facilities will be covered under the BDCP for existing operations criteria and for future criteria discussed below.

The BDCP includes conservation actions that will change land use and water operations in Suisun Marsh over time. These changes in land use and water operations are covered activities and are addressed by the BDCP. See Section 3.6.2 for a description of tidal brackish marsh restoration (CM4 *Tidal Habitat Restoration*) and Section 3.6.4.2 for a description of water operations (CM1 *Water Facilities Operation)*. The existing operation and maintenance of the Suisun Marsh Salinity Control Gates and other facilities would not change until BDCP actions require changes in their operation. Operations of the Suisun Marsh Facilities under the existing operational criteria, as well as changes to operation as described in CM1 would be covered by BDCP. Generally, as habitat restoration in Suisun Marsh is conducted with the implementation of BDCP conservation measures, and changes in land uses occur, the operation of the Suisun Marsh Salinity Control Gates will trend towards limiting the operation of the gates and increasing the period during which the gates allow tidal inflows into Montezuma Slough to provide for the conservation of covered fish species in conjunction with all other water operations under the BDCP.

The BDCP covers operations of the Salinity Control Gates and other Suisun Marsh facilities under the existing and future operational criteria and future construction and maintenance of tidal habitat in Suisun Marsh identified in CM1 and CM4. These activities/actions are included as covered activities and associated federal actions and the effects of those activities/actions are addressed by the BDCP.

3.6.4.2 North Delta and South Delta Water Conveyance Operational Criteria

Water conveyance operational criteria include north Delta diversion bypass flow criteria, south Delta OMR flow criteria, south Delta Export/Inflow Ratio, flow criteria over Fremont Weir into Yolo Bypass, Delta inflow and outflow criteria, Delta Cross Channel gate operations, Rio Vista minimum instream flow criteria, operations for Delta water quality and residence criteria, and water quality criteria for agricultural and municipal/industrial diversions.

Scenario A

North Delta Diversion Bypass Flow Criteria

The objectives of the north Delta diversion bypass flow criteria include regulation of flows to: (1) maintain fish screen sweeping velocities; (2) reduce upstream transport from downstream channels; (3) support salmonid and pelagic fish transport to regions of suitable habitat; (4) reduce predation effects downstream; and (5) maintain or improve rearing habitat in the north Delta.

The north Delta diversion bypass flow criteria comprise three parameters: Constant Low Flow Pumping, Initial Pulse Protection, and three levels of Post-Pulse Operations as summarized below.

- **Constant Low Flow Pumping—December through June.** Diversions of up to 5% of river flow can occur in periods when flows are greater than 5,000 cfs, with no more than 300 cfs diverted at any one intake.
- **Initial Pulse Protection.** Low-level pumping is maintained through the initial pulse period. After the pulse period has ended, water operations would return to the bypass flows presented in Table 3-9. (These parameters are for the purpose of modeling only; actual water operations would be based on real-time monitoring of fish movement.)
- If the first flush begins before December 1, the month of May bypass criteria must be initiated following first flush; the second pulse period would have the same protective operation.
- For the purpose of monitoring, the initiation of the pulse is defined by the following criteria: (1) Wilkins Slough flow change by more than 45% over a 5-day period, and (2) flows greater than 12,000 cfs. Low-level pumping continues until: (1) Wilkins Slough returns to pre-pulse flows (flow on first day of 5-day increase), (2) flows decrease for 5 consecutive days; or (3) flows are greater than 20,000 cfs for 10 consecutive days.
- **Post-Pulse Water Operations.** After initial flushes, implement Level I post-pulse bypass rule (Table 3-9) until the occurrence of fifteen (15) total days of bypass flows above 20,000 cfs. Then implement Level II post-pulse bypass rule (Table 3-9) until 30 total days of bypass flows occur above 20,000 cfs. At this point, implement Level III post-pulse bypass rule (see Table 3-9) so that bypass flows are sufficient to prevent upstream tidal transport at two points of control: (1) Sacramento River upstream of Sutter Slough, and (2) Sacramento River downstream of Georgiana Slough. These points of control are used to prevent upstream transport toward the proposed intakes and to prevent upstream transport into Georgiana Slough.

1 **Table 3-9. North Delta Bypass Flow Criteria: Post-Pulse Water Operations**

Level I Post-Pulse Operations			Level II Post-Pulse Operations			Level III Post-Pulse Operations		
If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…	If Sacramento River at Freeport flow is over…	But not over…	The bypass is…
December–April								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 80% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 60% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 50% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,600 cfs plus 60% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,400 cfs plus 50% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	12,000 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	18,400 cfs plus 30% of the amount over 20,000 cfs	20,000 cfs	No limit	15,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	13,000 cfs plus 0% of the amount over 20,000 cfs
May								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping
15,000 cfs	17,000 cfs	15,000 cfs plus 70% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 50% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 40% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,400 cfs plus 50% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	13,000 cfs plus 35% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	11,400 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	17,900 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	14,750 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	12,400 cfs plus 0% of the amount over 20,000 cfs

Level I Post-Pulse Operations			Level II Post-Pulse Operations			Level III Post-Pulse Operations		
If Sacramento River at Freeport flow is over...	But not over...	The bypass is...	If Sacramento River at Freeport flow is over...	But not over...	The bypass is...	If Sacramento River at Freeport flow is over...	But not over...	The bypass is...
June								
0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs	0 cfs	5,000 cfs	100% of the amount over 0 cfs
5,000 cfs	15,000 cfs	Flows remaining after constant low level pumping (main table)	5,000 cfs	11,000 cfs	Flows remaining after constant low level pumping (main table)	5,000 cfs	9,000 cfs	Flows remaining after constant low level pumping (main table)
15,000 cfs	17,000 cfs	15,000 cfs plus 60% of the amount over 15,000 cfs	11,000 cfs	15,000 cfs	11,000 cfs plus 40% of the amount over 11,000 cfs	9,000 cfs	15,000 cfs	9,000 cfs plus 30% of the amount over 9,000 cfs
17,000 cfs	20,000 cfs	16,200 cfs plus 40% of the amount over 17,000 cfs	15,000 cfs	20,000 cfs	12,600 cfs plus 20% of the amount over 15,000 cfs	15,000 cfs	20,000 cfs	10,800 cfs plus 20% of the amount over 15,000 cfs
20,000 cfs	No limit	17,400 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	13,600 cfs plus 20% of the amount over 20,000 cfs	20,000 cfs	No limit	11,800 cfs plus 0% of the amount over 20,000 cfs
July–September								
The bypass flow is 5,000 cfs			The bypass flow is 5,000 cfs			The bypass flow is 5,000 cfs		
October–November								
The bypass flow is 7,000 cfs			The bypass flow is 7,000 cfs			The bypass flow is 7,000 cfs		

South Delta Channel Flows Criteria

The objectives of the south Delta channel flows criteria are to minimize take at south Delta pumps by reducing incidence and magnitude of reverse flows during critical periods for pelagic species. The south Delta channel flows criteria use two parameters: OMR Flows and South Delta Export–San Joaquin River Inflow Ratio, as summarized below.

- **OMR Flows.** The criteria are based on concepts addressed in the 2008 USFWS and 2009 NMFS BOs related to adaptive restrictions for temperature, turbidity, salinity, and presence of delta smelt. The criteria, presented in Table 3-10, are considered to be an estimate of "most likely" water operations under the BOs for modeling purposes.
- **South Delta Export–San Joaquin River Inflow Ratio.** This ratio uses a sliding scale for flows in excess of the OMR criteria, as presented in Table 3-11, to share additional San Joaquin River flows between diversions at the SWP and CVP south Delta export facilities and environmental requirements. The export proportions would increase with rising San Joaquin River flows. This criteria also considers the time value of the benefit from using this ratio, including crediting outside of the period of time when the flows are acquired.

1 **Table 3-10. Old and Middle River Flow Criteria**

	Combined Old and Middle River Flows to be No Less than Values Below[a] (cfs)				
Month	Wet Water Year	Above Normal Water Year	Below Normal Water Year	Dry Water Year	Critical Dry Water Year
January	-4,000	-4,000	-4,000	-5,000	-5,000
February	-5,000	-4,000	-4,000	-4,000	-4,000
March	-5,000	-4,000	-4,000	-3,500	-3,000
April	-5,000	-4,000	-4,000	-3,500	-2,000
May	-5,000	-4,000	-4,000	-3,500	-2,000
June	-5,000	-5,000	-5,000	-5,000	-2,000
July	N/A	N/A	N/A	N/A	N/A
August	N/A	N/A	N/A	N/A	N/A
September	N/A	N/A	N/A	N/A	N/A
October	N/A	N/A	N/A	N/A	N/A
November	N/A	N/A	N/A	N/A	N/A
December[b]	-6,800	-6,800	-6,300	-6,300	-6,100

[a] Values are monthly average for use in modeling. Values are reflective of the "most likely" water operation under the 2008 USFWS Biological Opinion. Values for modeling may be updated based on review by the Fishery Agencies.

[b] December 20–31 targets are -5,000 cfs (Wet and Above Normal Water Years), -3,500 cfs (Below Normal and Dry Water Years), and -3,000 cfs (Critical Dry Water Year), and are averaged with an assumed background of -8,000 cfs for December 1–19.

Fremont Weir and Yolo Bypass Criteria

The objectives of the Fremont Weir and Yolo Bypass criteria are based on considerations for (1) increasing spawning and rearing habitat for splittail and rearing habitat for salmonids for windows greater than 30 days, (2) providing an alternate migration corridor to the mainstem Sacramento River, and (3) increasing the effectiveness of habitat and food transport in Cache Slough. The Fremont Weir and Yolo Bypass Criteria usefour parameters: Sacramento Weir, Lisbon Weir, Fremont Weir, and Fremont Weir Gate Operations, as summarized below.

- **Sacramento Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Lisbon Weir.** No change in current operations. Improve upstream fish passage facilities.
- **Fremont Weir.** Improve fish passage by constructing an opening and installing operable gates and fish passage facilities at elevation 17.5 feet. In addition, construct a smaller opening with operable gates and fish passage enhancement at elevation 11.5 feet.
- **Freemont Weir gate operations.** From December 1 to March 30 (may be extended to May 15, depending on hydrologic conditions and measures to minimize land use and ecological conflicts), open the 17.5-foot and 11.5-foot elevation gates when Sacramento River flow at Freeport is greater than 25,000 cfs to provide local and regional flood management benefits, while coinciding with pulse flows and juvenile salmonid migration cues, and to provide seasonal floodplain inundation for salmonid food production, juvenile rearing, and spawning. This action would cause Yolo Bypass inundation of 3,000–6,000 cfs depending on river stage and would require an operations plan to reduce or avoid impacts on water supply associated with north Delta bypass flow constraints.

The 17.5-foot elevationgates wouldbe closedwhen Sacramento River flowat Freeport recedes to less than 20,000 cfs, but the 11.5-foot elevationgate wouldremain open to providegreater opportunity for fish in the YoloBypass to migrate upstreaminto the Sacramento River.The 11.5-foot elevation gates wouldbe closedwhen Sacramento River flowat Freeport recedesto lessthan 15,000 cfs.

Delta Cross Channel Gate Operations Criteria

The objectives of the Delta Cross Channel gate operations criteria, summarized below, are based on considerations to (1) reduce transport of outmigrating Sacramento River fish into the central Delta; (2) maintain flows downstream on the Sacramento River; and (3) provide sufficient Sacramento River flow into the interior Delta when water quality for municipal, industrial, and agricultural users may be of concern.

- **October–November.** Delta Cross Channel gates closed if fish are present (for modeling, assumed closed 15 days per month; may be longer depending upon actual presence of fish).
- **December–June.** Delta Cross Channel gates closed.
- **July–September.** Delta Cross Channel gates open.

Rio Vista Minimum Instream Flow Criteria

The objectives of the Rio Vista minimum instream flow criteria, summarized below, are to maintain minimum flows for outmigrating salmonids and smelt.

- **September through December.** Operate in accordance with State Water Board D-1641.

- **January through August.** Minimum of 3,000 cfs.

Delta Inflow and Outflow Criteria

The objectives of the Delta inflow and outflow criteria are to (1) provide sufficient outflow to maintain a desirable salinity regime downstream of Collinsville during the spring, and (2) explore a range of approaches toward providing additional variability to Delta inflow and outflow. These criteria are intended to provide the basis to operate in accordance with State Water Board D-1641 when proportional reservoir releases occur to provide responses for Delta inflows and outflows and upstream storage conditions.

Operations for Delta Water Quality and Residence Criteria

The objectives of the operations for Delta water quality and residence criteria, summarized below, are to (1) maintain a minimum level of pumping from the south Delta during summer to provide limited flushing to reduce residence times and improve water quality; (2) provide salinity improvements for municipal, industrial, and agricultural water users; and (3) allow operational flexibility during other periods to operate either north or south diversions based on realtime assessments of benefits to fish and water quality.

- **July–September.** Preferentially operate SWP and CVP south Delta export facilities up to 3,000 cfs of diversions before diverting from north Delta intakes.
- **October–June.** Preferentially operate north Delta intakes.

In-Delta Municipal, Industrial, and Agricultural Water Quality Requirements Criteria

The in-Delta municipal, industrial, and agricultural water quality requirements criteria would require the SWP and CVP to comply with existing agreements with water rights holders related to operations of the SWP and CVP. These requirements include water operations in accordance with State Water Board D-1641 related to north Delta and western Delta agricultural and municipal and industrial requirements, except that the Sacramento River compliance point for the agreement with the North Delta Water Agency would be moved from Emmaton to Threemile Slough.

Scenario B

[*Note to reviewers: detailed description pending*.]

Scenario B would incorporate criteria for the same elements as those referenced under Scenario A. These include parameters outlining: north Delta diversion bypass flows; south Delta channel flows; Fremont Weir/Yolo Bypass operations; Delta Cross Channel Gate operations; Rio Vista minimum instream flows; Delta inflow and outflow; Delta water quality and residence time standards; and in-Delta agricultural, municipal, and industrial water quality requirements ("Scenario 6," Rationale for Five Agency Proposed Alternative BDCP Initial Project Operations Criteria, 5/18/11). This scenario would add an operable barrier at Head of Old River. This scenario applies to Alternatives 2A, 2B, 2C, and 4.

Scenario C

[*Note to reviewers: detailed description pending*.]

Scenario C would adopt the operational guidelines of Scenario A north of the Delta. South of the Delta, this Scenario would rely upon existing Biological Opinions with criteria related to Fall X2, Old and Middle River flows, and San Joaquin export and inflow ratio. This scenario applies only to Alternative 5.

Scenario D

[*Note to reviewers: detailed description pending*.]

Scenario D would be modified from Scenario A to eliminate use of south Delta intakes and add criteria surrounding Fall X2. This scenario applies to Alternatives 6A, 6B, and 6C.

Scenario E

[*Note to reviewers: detailed description pending*.]

Scenario E would be modified from Scenario A. This scenario applies only to Alternative 7.

Scenario F

[*Note to reviewers: detailed description pending*.]

Scenario F is under development and could include up to 1.5 maf in increased Delta outflow. This scenario applies only to Alternative 8.

Scenario G

[*Note to reviewers: detailed description pending*.]

Scenario G would be similar to those described under Scenario A but would be modified to conform to the conveyance components of the separate corridors option. This scenario applies only to Alternative 9.

3.6.4.3 Capacity of Water Supply Facilities

[Note to reviewers: this is a data/information gap and will be completed as information is prepared.]

3.6.4.4 Conveyance System Hydraulics

[Note to reviewers: this is a data/information gap and will be completed as information is prepared.]

3.7 Project Implementation Schedule

[*Note to reviewers: completion of this section is pending*]

3.8 Environmental Commitments

As part of the project planning and environmental assessment process, DWR will incorporate certain environmental commitments and best management practices (BMPs) into the BDCP alternatives to avoid or minimize potential impacts. DWR will also coordinate planning, engineering, design and construction, operation, and maintenance phases of the Plan with the appropriate agencies. Environmental commitments that will be incorporated in the project are described in Appendix __, *Environmental Commitments* [*Note to reviewers: completion of this appendix is pending*].

3.9 References

National Marine Fisheries Service. 2009. Biological Opinion and Conference Opinion of the Long-Term Operations of the Central Valley Project and State Water Project. June 4. Southwest Region.

U.S. Fish and Wildlife Service. 2008. Formal Endangered Species Act Consultation and Biological Opinion on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP), December 15.